AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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Universal Grinder.

In our issue of Aug. 28, 1890, we illustrated and described a new universal grinder, which has, since that time, made its way into a number of well-known machine shops, and, as is usual with new machines, has been improved somewhat as varied experience with it seemed to indicate the advantage of. These improvements and the general construction of the machine are made clear by the accompanying engravings.

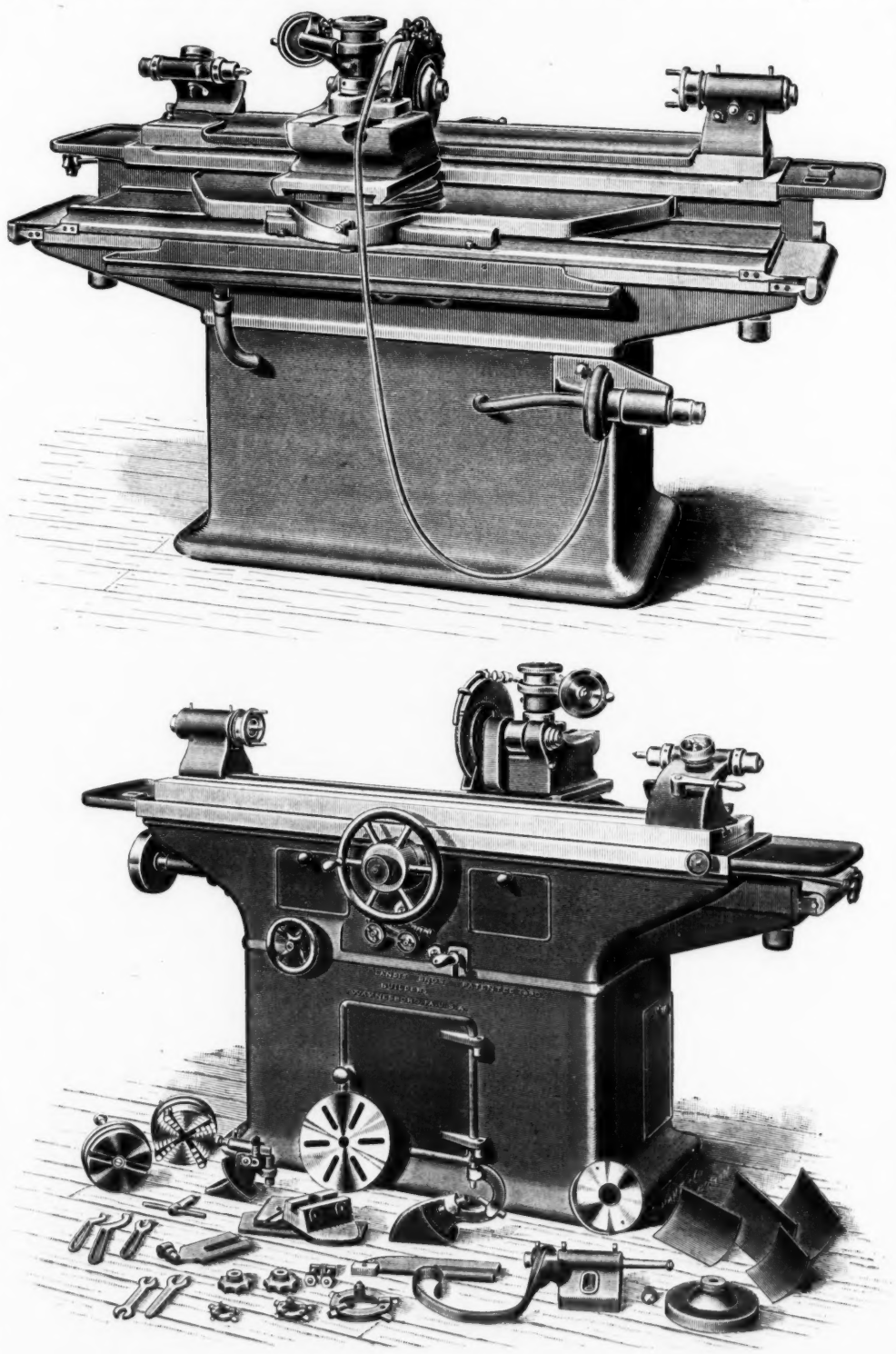
On this page are the engravings showing a front and a rear view of the machine, with its attachments, those showing sections, details, etc., appearing on following pages.

In this machine the plan has been adopted of placing the head and foot stocks upon a swiveling plate which turns upon a stationary portion of the bed, and the wheel is upon a moving carriage behind it. Friction disks are employed to vary the rate of speed of the work upon the centers and the traverse of the emery wheel, these movements being changeable at will, and through a very great range, while the machine is in motion. Referring to Figs. 1 and 2, the general arrangement of the parts will be understood, a portion of the frame of the machine in Fig. 1 being broken away to show the arrangement of the friction disks for varying the speed of traverse of the wheel. Motion is transmitted from one to the other of the two vertical friction disks by means of the movable horizontal friction disk, this being raised or lowered by means of a rack-and-pinion movement controlled by the hand-wheel indicated, and the range being from $\frac{1}{64}''$ to $\frac{1}{4}''$ per revolution of the work. The sectional view, Fig. 3, shows the remainder of the feed mechanism, the two "reverse varying knobs" serving to change the position of two threaded wheels which are upon the main traversing shaft, these wheels bringing about the reverse of the motion. Turning the right-hand knob to the right moves the point of reverse at the right further in that direction, while turning the left-hand knob to the left moves to the left the left-hand reverse. Small worms and wheels are upon these knobs, enabling the points of reverse to be changed by .001″ in either direction—a very good feature when grinding is to be done close to a shoulder. By the upper large hand-wheel the emery wheel is traversed by hand, a rapid motion being imparted when the knurled disk at the center of this wheel is tightened to the right, and a much slower motion when it is tightened to the left, an intermediate position leaving this wheel loose, so that it need not turn with the motion of the wheel when traversing by power.

At either end of the slides upon which the emery-wheel carriage moves are curtains of waterproof material, which are upon rollers, and wind or unwind as the carriage moves, covering that portion of the ways that would otherwise be exposed. As the carriage passes over the end of the slides, it takes up the rollers and carries them along with it, restoring them to place as it returns. By this means less room is required to operate the machine than would be needed were fixed protectors used, and there is less overhanging weight.

The wheel is moved to and from the work by means of the hand-wheel shown at the right of the emery wheel, this hand-wheel being at the end of a shaft which carries a worm and imparts motion to a vertical pinion shaft, the pinion engaging with the rack. This hand-wheel is found to be in a very convenient position when bringing the wheel up to the work has a stop by which it may be brought back to any given position precisely, and is graduated in two ways, as shown in Fig. 22, so that a movement of $\frac{1}{2000}''$, corresponding to .001″ reduction of diameter, may be given; or the wheel may be moved to give a reduction of .0001″ diameter, graduations being provided for this.

This provision for fine adjustment makes the movement of the wheel necessarily very slow, and for a more rapid movement, a wing nut at the top of the vertical pinion shaft may be loosened, when the wheel may be rapidly traversed in and out by means of the knurled disk at the top of the shaft. In addition to this there is another means of moving it which is especially adapted to grinding shoulders or radial surfaces upon work, or for grinding snap gauges. This motion is obtained by loosening one bolt which clamps in position the arm which carries the horizontal shaft; this arm with the hand-wheel then becomes a lever which, swung in a horizontal plane, moves the wheel in and out, or at any angle to which the wheel slide may be set.



UNIVERSAL GRINDER.

Fig. 3 shows also how provision is made for supplying an abundance of water to the wheel without having it run or fly all over the machine, and things are so arranged that this water may be used with equal facility on any kind of work whatever, thus keeping the temperature of the work uniform and conducing to accuracy.

In this figure, also, is shown the method adopted for keeping the foot-stock always accurately in line, this being accomplished by the use of a square shoulder at the back of the platen against which the foot-stock is drawn by the tightening bolt, which is placed at an angle for that purpose, as shown. The square shoulder is carefully scraped to a proof staff, so that it is straight, and as there is practically no wear upon it, and the foot-stock is always sure to be brought up against it when tightened, there is no trouble from lack of alignment. The foot-stock is clamped by the simple movement of a lever, and the spindle is advanced to the work by a spring, the tension upon which is adjustable, or the spindle may be clamped in any position at will, the construction for this being shown at Fig. 18, which also shows the adjustable bearings for the foot-stock spindle.

At Fig. 17 is a section of the head-stock showing the arrangement of the spindle boxes, these being adjustable for wear by turning them in their places, and in doing this they do not alter their endwise adjustment. The head-stock does not swivel upon a graduated base of its own, but the graduations at the end of the swiveling platen are available for this purpose, and when angles beyond the scope of this adjustment are to be ground, the spindle with its boxes is lifted out of place and put into a grooved block, which is so arranged that any desired angle may be obtained, grooves being provided which give directly the most common angles, such as that for centers, while the others are obtained by the use of the graduations spoken of, which are shown in Fig. 18, where it will be seen that they are of two kinds, one indicating taper in inches to the foot, while the other indicates angles in degrees. The value of these graduations is 18″ per foot and $\frac{1}{4}°$ respectively, the extreme swing of the platen, either side of the table, being 16°, or for 6″ per foot taper. This, in connection with the fact that the wheel can be moved at any angle from 0 to 90° with the ways, gives ample facilities for grinding any desired angle or taper.

The device for clamping the swiveling platen is shown at Fig. 5. The platen is clamped simultaneously at both ends by the movement of the small hand wheel at the right, and all this mechanism, as well as the screw for fine adjustment, is under the platen, where it is not exposed to dust, this construction also enabling the ends of the platen to be made very plain and simple outside, so that they do not readily catch or hold dust.

At Fig. 19 is a section showing the arrangement of the emery-wheel spindle, this

being of hardened steel, ground and running in phosphor-bronze boxes, the main box extending out within the wheel, as shown, and the wheel being so mounted that it is a very easy matter to remove it from the spindle, and make any change desired, the thread on the end of the spindle and the taper seat serving to hold and center the flanges between which the wheel is secured. It is designed to have a sufficient number of these flanges to enable the operator to make such changes as the character of the work may demand without disturbing the mounting of the wheels, the spindle or its boxes. All the spindles are hardened and ground.

At Fig. 20 a section of the internal grinding arrangement is given, this being so arranged that the spindle is supported by a bronze bearing as near the wheel as possible, the outer sleeve being stationary, and consequently more rigid than would be possible were it to run in a bearing within the head.

It will be noticed that the traversing mechanism is all inclosed within the bed, where it is protected from dirt and dust. The base of the machine forms a closet for the reception of small parts and attachments, the rear portion of this space being devoted to the water tank, which can be removed through the door at the end of the machine, as shown.

The overhead works are entirely self-contained, and need only to be raised to the ceiling and secured. The work is started and stopped by turning a suspended rod, while another rod enables the speed of the work to be very quickly varied from 20 to 500 revolutions per minute.

In a future near issue we shall present some further engravings showing how certain operations are performed upon the machine, which is built in two sizes by Landis Brothers, Waynesboro, Pennsylvania.

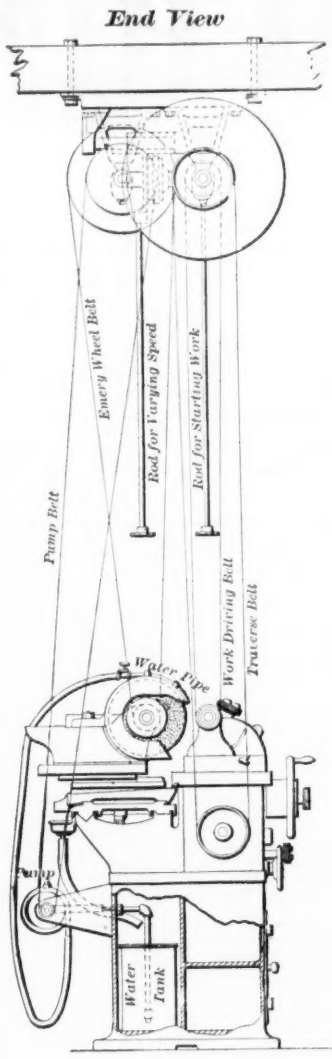


Fig. 2

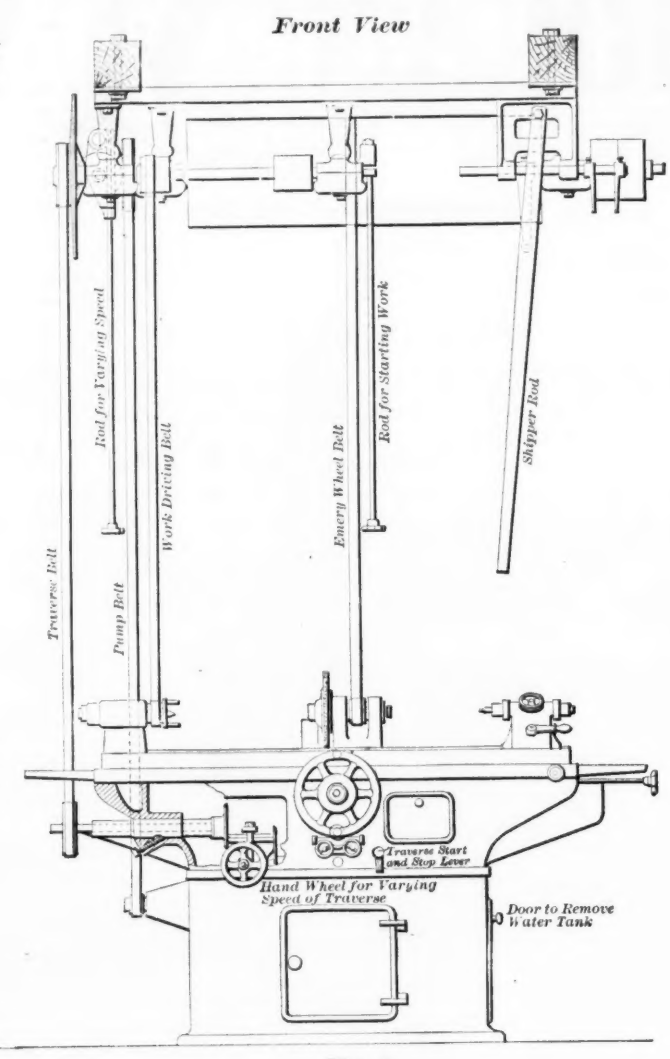


Fig. 1

Central Sectional View

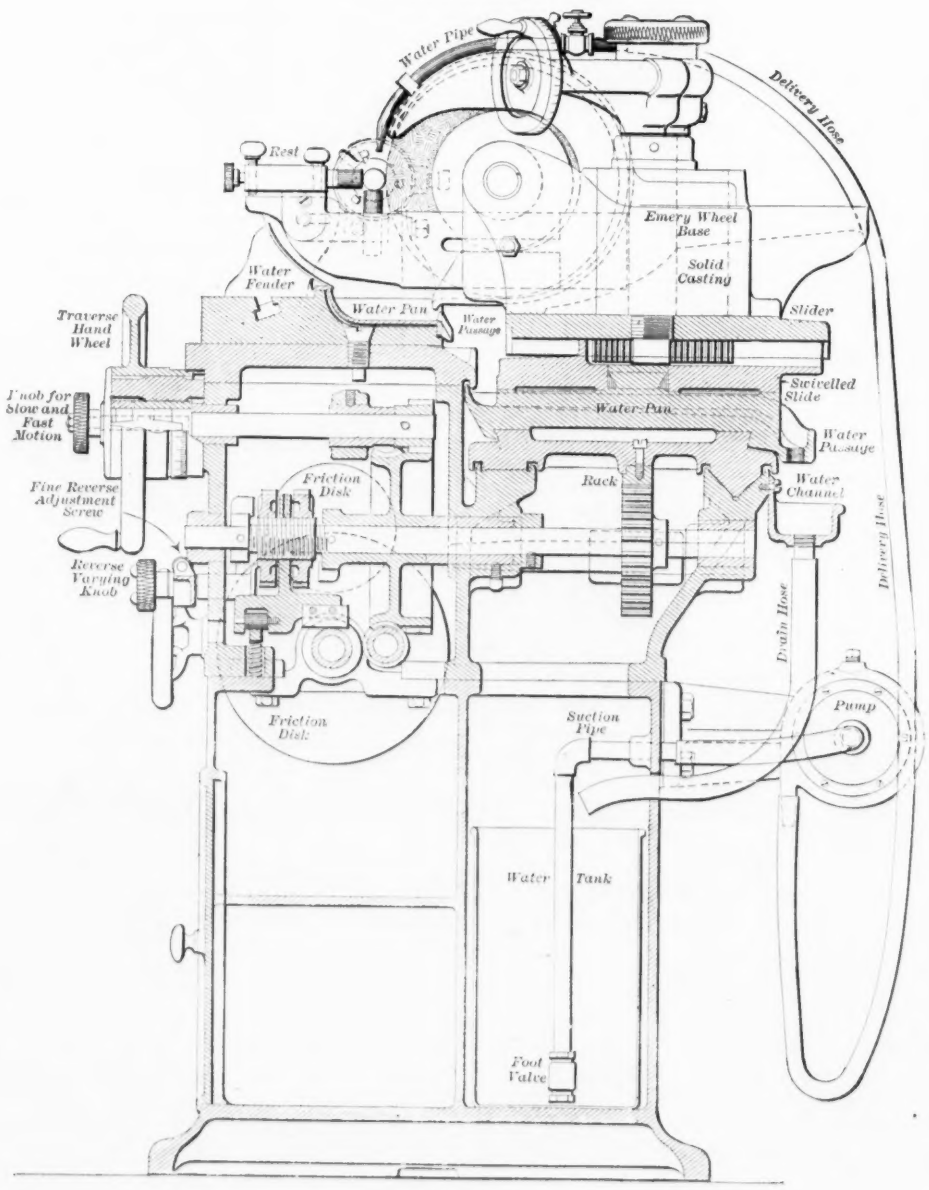


Fig. 3

UNIVERSAL GRINDER.—SEE PAGE 1.

Feed Heating in a Condensing Engine.

BY W. H. BOOTH.

I have had occasion to observe certain errors into which men are apt to fall when considering the question of feed heating by exhaust steam from a condensing engine. We know that because the exhaust steam is always wet, its temperature must always be that due to its pressure, and these figures can be obtained from any of the numerous books which contain tables of the property of steam. It is argued with a good show of reason, that in its passage from the cylinder to the condenser a good deal of the heat of the exhaust steam might be absorbed by a feed-water coil, just as in the case of a non-condensing engine which exhausts to the atmosphere. The minimum back pressure in a non condensing engine is, of course, something greater than the atmospheric pressure, from which it follows that the temperature must be at least 212° Fahr., and its total heat about 1,147 units per pound, of which the bulk is available for heating the feed and for other purposes. Of course, we can never heat the feed above the boiling point, and as each pound of exhaust implies a pound of feed water which comes into the coil at about 62°, we can easily see that 150° is the maximum addition of heat which it is possible to give to the feed water. The available heat in a pound of the exhaust is about 934° if the whole is reduced to water at 212°, but this is fully six times the amount which can be absorbed by the feed water, from which we learn that the feed of a battery of six boilers can be heated by the exhaust steam of an engine which can be driven by one boiler alone. Where there is a use for exhaust steam for boiling purposes we need not be afraid of first employing it to heat a feed coil.

The case of the condensing engine is somewhat different. The back pressure on the cylinder is, we will say, 3 pounds, the temperature corresponding to which is about 142°. This is the maximum temperature to which a feed coil in the exhaust could possibly be raised, and with the same initial temperature of 62° as above assumed the added temperature will be only 142 — 62 or 80°, but the available heat, as we may find from the steam table, is (1,015.2 — 141.67) roughly 873° or nearly eleven times what can be absorbed. In practice, therefore, the saving of heat by a coil in a condensing engine is about half of what it is in the high-pressure engines.

It is a fact, however, that though the cylinder temperature may be 142° that of the condenser will probably be as low as 100°, the difference being due to want of rapidity of action between condenser and cylinder. It would, however, be a mistake to suppose that the condenser temperature is the limit to which a coil would be heated; but the fact of the difference should teach us to let the feed water enter the coil at the condenser end and leave it at the end nearer the cylinder, thereby securing the benefit of the higher cylinder temperature. Such a system of feed heating can only reduce the amount of work to be done in the condenser by about 10 per cent, and can only save about 5 per cent. of fuel. It is not therefore a practice to be followed unless it can be contrived without obstructing the exhaust. Its fittest point of application is, therefore, in a vertical length of exhaust pipe, any water formed passing by gravity to the condenser below.

Those who have had much experience of flue feed heaters of the vertical pipe description which receive the cold water at their lower ends and discharge to common main at their upper ends, and are generally known by the name of "economizers," will be aware of the very rapid corrosion which takes place of the lower pipe boxes and the lower 18 inches of the pipes. This, it is recognized, is caused by the condensation upon the pipes of steam, more or less acid from the sulphur burned out of the fuel. Above the lower 18 inches the feed has absorbed sufficient heat to prevent condensation, and these "economizers," which cost about $5 per pipe, are worn out when they are still five-sixths in good order. Where the feed water comes from the condenser discharge much of the above corrosion is prevented, the feed going into the economizer at 100°. By conveying the feed through a coil and adding still further to the temperature all corrosion of the external surface of the economizer pipes may be put a stop to, whereby the life of an economizer may be prolonged many years. There is a tendency to reduce the amount of injection in order to raise the condenser temperature for this very purpose, but this will vitiate the vacuum, and the additional coil seems better calculated to secure economy and not reduce the engine power as would a rise of the condenser temperature.

It has often appeared to me that in works where much hot water is required this might be secured for much less expense by making it perform condensing duty, leaving only to live steam the duty of putting in the heat beyond the point past which the exhaust steam cannot raise it. There is an idea abroad that in a condensing engine all the steam must necessarily go to the condenser but there is no absolute reason for this.

It is a pitiable sight to see the laborious toil of an overworked fireman upon a boiler said to be too small for its work and to find at the same time that water is being entirely heated by live steam, and high-pressure engines are discharging at a point where the exhaust is a nuisance. To be refused credence on pointing

out these wastes is perhaps the common lot of engineers, and yet we all know of such places, and I have one such in my mind at the moment where they contemplate adding a boiler to burn more coal at a cost in excess of what would render the present boiler too large.

Proposed Tests of Engines and Boilers at the World's Fair—Circular No. 1.

MEMORANDA REGARDING TESTS.

DEPT. F. (MACHINERY) GROUP 69, CLASSES 413 AND 415.

The undersigned, members of the Sub-Committee of Jurors of Department F. assigned to Classes 413 and 415, Group 69, believe that measurements of performance of steam machinery and appliances are essential to their valuation as exhibits; and they further believe that such measurements will secure information of greatest importance to the public regarding the commercial value of the principles represented in the construction and operation of the leading types of steam apparatus in the Exposition, as exhibited by the different nationalities. We therefore propose to make certain tests upon the appliances mentioned in the following list, the reasons for these tests and the preparations required for them being briefly noted.

I.—THE QUADRUPLE EXPANSION ALLIS ENGINE.

This engine represents the most advanced design of steam engine. No public determination of the possibilities of such an engine as to economy has been made up to the present time. It is highly consistent with the educational interest of the Exposition that a careful and thorough investigation of its performance be made. The simplest and cheapest way to make the necessary preparations is to connect one of the boilers with the engine through an independent steam main specially provided for the work, so that the boiler pressure carried while testing may be, if desired, 150 pounds (now limited on account of headers to 120 pounds) and provision may be made for measuring the feed water supplied to the boiler. This main can be provided with a separator near the engine to remove water formed by condensation and priming.

The load may be adjusted by the employment of a suitable number of lamps so as to obtain the desired amount of power.

II.

The economy of the Fraser & Chalmers engine should be determined, inasmuch as the engine is a representative example of a modern triple engine of the Corliss slow-speed type. The Buckeye triple engine should also be tested as an example of a two-valve engine with shaft governor. Further, the German engine exhibited by E. Schichau, Ebling, Germany, of the vertical triple type, should be tried as an example of Continental foreign practice, as also the Galloways compound engine to serve as a representative English machine. With the exception of the Buckeye engine, which is fitted with a surface condenser, each of these engines will require the erection of an independent steam main connecting to the nearest boiler, with separator. The surface condenser of the Buckeye engine provides means of measurement for this engine without much change of piping.

III.—THE ALLIS VERTICAL COMPOUND ENGINE.

The vertical Allis engine embodies a novel principle calculated to produce economy under variable loads. The new principle lies in the valve gear, which is operated so as to preserve a fixed initial pressure and cut-off whatever the amount of load. Whenever the load is less than that corresponding to this cut-off, the resulting increase of speed causes the governor to shut off altogether the supply of steam, and, as in the gas engine, no further admission occurs until a reduction of the speed below the normal causes the governor again to open the admission valve. The novelty of this principle is sufficient to warrant a test, and it should be made in a series covering several loads.

In preparation for this test, an independent steam main, a continuation of one of those used for other tests, will require to be erected, and means provided for loading the engine with a dynamo and electric lights.

IV.—THE WESTINGHOUSE COMPOUND ENGINE.

This type of engine contains a feature which is intended to secure special economy of steam under variable loads, such as those met in electric railroad service. It consists in the use of a large clearance volume in the high-pressure cylinder so as to restrict the range of pressure and temperature during expansion. It is desirable to determine the performance of one of the engines having this feature (the 330 H. P. in space No. 21 being suitable) and do this under three or more loads, both condensing and non-condensing; a similar number of tests being made on another type of high-speed engine in which this feature does not exist (see next section). To prepare for this test the exhaust pipe may be connected temporarily to the surface condenser of one of the 1,000 H. P. Westinghouse engines, which is available for the purpose.

V.—THE BALL AUTOMATIC CUT-OFF COMPOUND ENGINE, AND OTHERS.

Referring to Section 4, a corresponding series of tests should be made upon the 500 H. P. Ball engine, as representative of one class of high speed engine of the common type. An independent steam main is to be run for this engine.

VI.—THE WILLANS & ROBINSON ENGINE.

The Willans compound engine No. 6 should be tested as an example of a well-known high speed vertical compound engine of the English make. Here a new steam main must be provided. It is desirable also to make a test of the compound condensing portable engine exhibited by R. Wolf, Magdeburg, Germany.

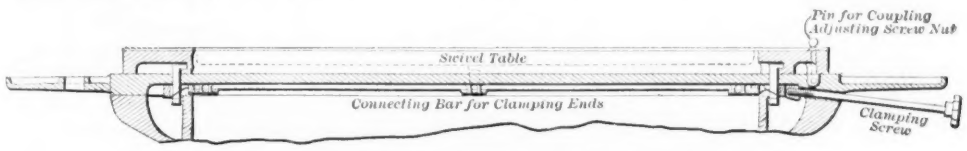
VII.—BOILER TESTS.

Each type of boiler exhibited in the main boiler house and annex, embracing the Aberdroth & Root, Gill, Heine, National, Campbell & Zell, Babcock & Wilcox, Stirling and Climax should be tested with oil for both economy and capacity; and coal tests for economy should be made on the Climax and Stirling boilers using Illinois lump coal and Pocahontas coal (these two boilers being selected on account of their being comparatively new types). To measure the feed water for these tests, a set of weighing tanks is required (one set for the whole series of tests); likewise a set of tanks for weighing oil, and a pump for discharging the same into the furnace, also scales for both fuel and water. It is also desirable to make a coal test on the water tube boiler exhibited by Messrs. Duerr & Co., Retingen, Germany.

VIII.

These tests can only be undertaken at the expense of the individual exhibitors who desire to have the data determined by the

(Continued on page 9.)



Section showing Table Clamping Device.
Fig. 5

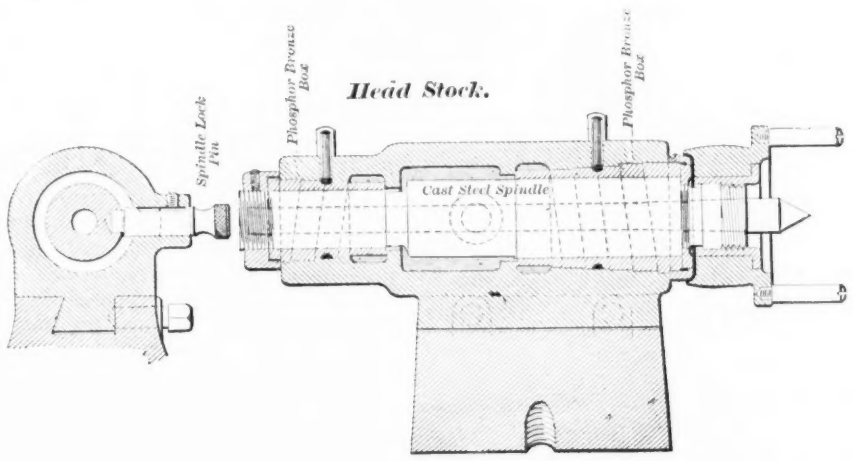


Fig. 17

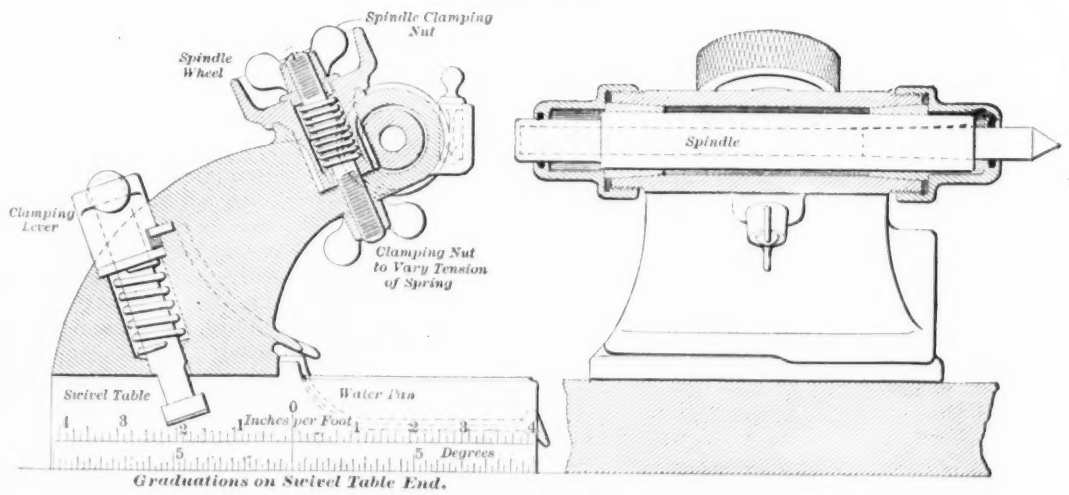


Fig. 18

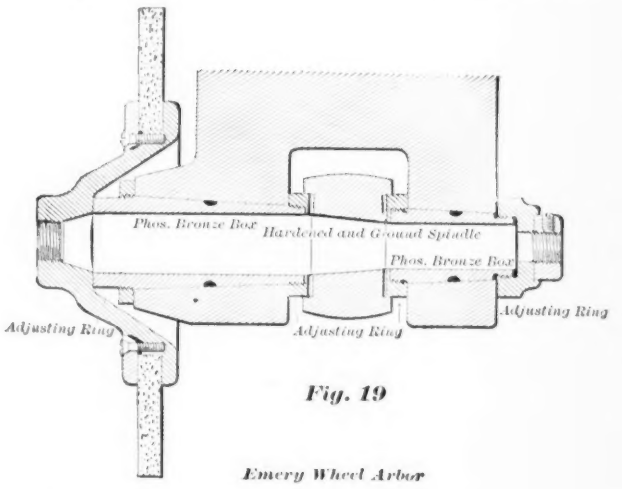


Fig. 19

Emery Wheel Arbor

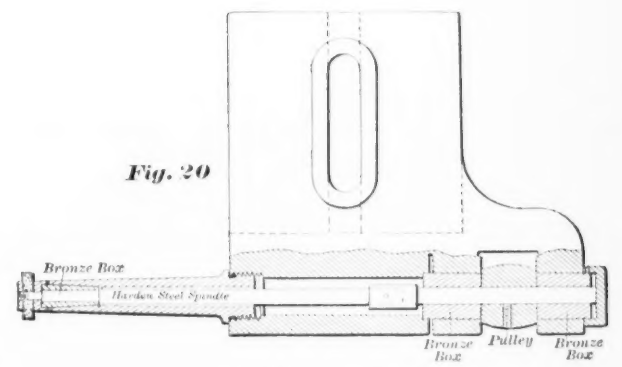
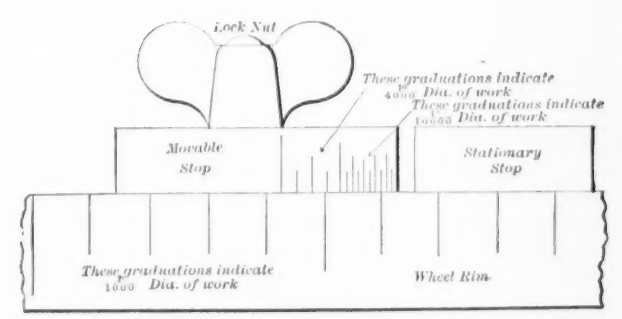


Fig. 20

Internal Grinding Fixture


Lock Nut
These graduations indicate 30/1000 Dia. of work
These graduations indicate 15/1000 Dia. of work
Movable Stop
Stationary Stop
These graduations indicate 1/1000 Dia. of work
Wheel Rim

Full Size of graduations on Emery Wheel adjusting Hand Wheel

Fig. 22

UNIVERSAL GRINDER.—SEE PAGE 1.

Columbian Exhibition Notes—X.

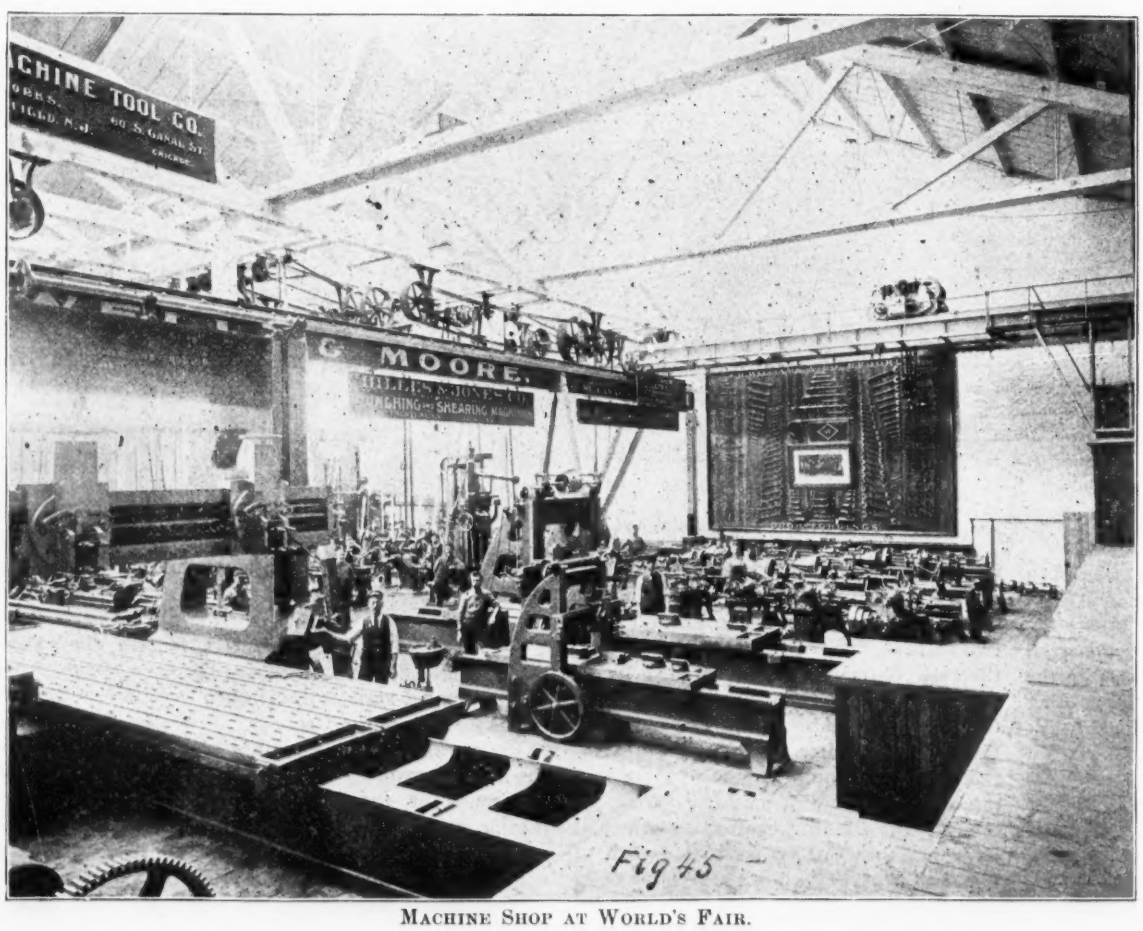
Editorial Correspondence.

THE MACHINE SHOP.

In giving some account of American machine tools to be seen here we may as well begin with the machine shop in which the repairs and such other machine work as may be required are done. As shown by a plan of Machinery Hall already published in our columns, this shop is located in the annex to Machinery Hall, west of the boiler rooms. The photographs, Figs. 44 and 45, were taken from a platform which is on a level with the floor of Machinery Hall, but about four feet above the floor of the machine shop, this platform being the point from which visitors get their view of the shop, unless they happen to be sufficiently interested in it to go down upon the floor. Both the photographs were taken from a point near the middle of the platform, Fig. 44 looking toward the north end, and Fig. 45 to the south. At the extreme left of Fig. 44 is the office of Manning, Maxwell & Moore, of New York, who have furnished the equipment of the shop—the product of establishments in which they are interested or for which they are the general sales agents. The office is nicely fitted up, and is a favorite visiting place for machinery men, partly, perhaps, because a man when here is in a city of refuge where the "tin soldiers" are unable to enforce the rule against smoking, and cigars abound. The only machinery in the office is under a glass case. It is made by Sloan, Chase & Co., of Newark, N. J., and consists of two small bench lathes for machinists' and tool makers' use, with attachments for doing all kinds of special work, such as is done on watch and other fine tools.

MACHINE SHOP AT WORLD'S FAIR.

Just outside and in front of the office is the display of the Westcott Chuck Co., who show what seem to be nearly all possible styles and variations of lathe and drill chucks, including a new independent lathe chuck, in which there are, behind the jaws and within the body of the chuck, what are called steel carriers, which are movable radially within the body of the chuck, and are threaded at one side for the reception of one-half of a set-screw, the other half having a bearing within the body of the chuck, thus distributing the strain better, and adding considerably to the capacity of the chuck, since the carriers can be moved out to project beyond the body of the chuck if desired, and yet a full bearing is retained for the jaws. A chuck 13½" diameter made in this way has a maximum capacity of 17" for holding work.



MACHINE SHOP AT WORLD'S FAIR.

At the right of the chucks is seen some car-wheel and axle machinery built by the Pond Machine Tool Works, of Plainfield, N. J., and consisting of a car-wheel borer with facing attachment and a new form of attached crane, an 84" wheel press, and two axle lathes (a double and a single), these being nearly concealed by the 48" triple-geared lathe, of which a good view is obtained. This lathe is from new designs, and has the gears in front, so that they tend to force the spindle down and balance the upward strain of the cut. The arrangement of the gears will probably be readily understood from the photograph, there being the usual quill with an additional pinion just inside the large gear, this pinion driving the larger gear below it, which is on a shaft carrying a pinion that engages with the face-plate gear, the necessary shifting being accomplished by means of the small hand-wheel shown, which works a rack and pinion. The slow gearing of this lathe is in the ratio of 52 to 1, and the cone is for a 5" belt.

Beyond the lathe is a 6-foot boring-mill, which takes work 48" high under the rail, and weighs 28,000 pounds. This mill is driven by a worm and wheel, and for the slow motion there is a pinion at the top of the vertical worm-wheel shaft engaging with a large internal gear, while for the faster motion a pinion upon a second vertical shaft engages with a smaller spur gear, the internal gear and the spur gear being in the same plane, and the pinions shifting vertically to make the changes in the driving, bevel gearing being dispensed with.

In the foreground of Fig. 44 are two planers by the same builders, the largest of these being a 120" machine to plane 25 feet long, and with a bed 44 feet long. It has four heads, both the side heads as well as the others swinging to any angle. It has one V and one flat way as shown, automatic tool lifters, power hoist for cross-rail, etc. The machine weighs about 150,000 pounds.

The smaller planer in front of the large one reappears in Fig. 45, it and the one beyond it being also by the Pond Machine Tool Co., these smaller machines, as well as the larger one, all having uprights of the box form of cross-section.

Beyond the planers is a 6 foot radial drill by the same builders, and having a fixed rectangular column, to the face of which is fitted a saddle carrying the arm. The gearing is at the spindle, a belt running along the top of the arm to transmit the motion.

Beyond this drill are seen two milling machines (one plain and one universal) built by the Kempsmith Machine Tool Co., of Milwaukee—tools with which our readers are familiar.

At the right of these are grouped a line of lathes from 10" to 30" swing, made by F. E. Reed, of Worcester, Mass., which, of course, need no introduction to our readers, and with them are some brass-working tools made by the American Tool Company of Boston.

None of the tools referred to are belted, but behind them is a full line of tools which are in use, and include lathes, drill presses, planers, etc., by the Pond Machine Tool Co.; sensitive drill by the Sigourney Tool Co.; Leland, Falconer & Norton tool grinder; two Gould & Eberhardt drill presses, one with tapping attachment; two shapers by the same builders; pipe cutting and threading machinery by D. Saunders' Sons; punching and shearing machinery by Hilles & Jones, and an Acme bolt cutter (1½"). Most of these machines are familiar to readers of this paper, having been illustrated and described in its columns, and it is therefore unnecessary to describe them now.

In one corner at the rear of the office there is a Tabor molding machine which stands upon an elevated platform, and is connected to steam pipes so that it can be operated, the molds it is making being for car axle brasses. Molding machines are as yet by no means as common as many other kinds of machinery, and as this is the only one exhibited, and probably the first one ever shown in operation at an exhibition, it attracts a great deal of attention.

At the right of Fig. 45 is seen the "Shaw" three-motor electric traveling crane, which covers the space occupied by the platform, the heavier tools, and the Reed lathe exhibit. This crane is called three motor because a separate motor is employed for each of the three motions, thus dispensing with gearing for transmission from a single motor. The crane shown is of ten tons capacity; its motions are under perfect control, and can be instantly changed from the maximum to a motion which, though steady, is scarcely perceptible. The maximum speed of hoisting is 19 feet (the full amount of head room here) in 17 seconds, and the load can be moved horizontally 300 feet per minute. There are two brakes upon the hoisting mechanism, one mechanical and the other electrical, *i. e.*, the latter brake is applied by means of two solenoids, which are operated whenever the current is switched off, these acting to apply a brake which is in itself mechanical enough, and is of the "clam shell" pattern. At each end of the bridge there is a dead section of wire which cuts off the current from the motor, which moves the trolley as the latter approaches the end of the

bridge, and thus prevents accidents, though when the current is really required within this space it can be thrown in by a snap switch, which must be operated by the man in charge of the crane. The crane works well, as a few trips upon it demonstrate, its smooth working being probably largely due to the small amount of gearing used, though the fact that what is used is good gearing has, of course, its influence, the bevel gears for instance being cut by Bilgram.

On the wall below the crane is seen the display of drop forgings made by J. H. Williams & Co., of Brooklyn, N. Y. who

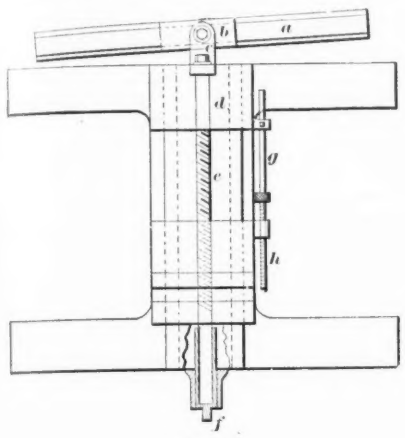


Fig. 46

show about 2,000 forgings of all descriptions for builders of electrical machinery, bicycles, tools, and for miscellaneous purposes. Besides those that are fastened to the board there are others which lie upon a shelf below it and can be examined, along with some representative dies such as are used in the production of the work. The forgings range from the smallest to those which weigh as much as 96 pounds, these latter being the field magnets for the Crocker-Wheeler Company's dynamo. Most of the work is of iron or machinery steel (much of it finely case-hardened), but there are gauges made for the Brown & Sharpe Mfg. Co., and bicycle parts made for Stirling Elliott's "Hickory" bicycle, which are of tool steel, and all are excellent specimens.

At the right of this display is that of the Keystone Mfg. Co., of Buffalo, N. Y., who show in parts and in a completed state specimens of their "Nonpareil" ratchet wrench, which was illustrated in our columns a few months ago, and which is made up entirely of Williams' drop forgings.

The overhead shafting in this shop is divided into two parts, as shown, each driven by a separate electric motor.

There is a blacksmith shop connected with this machine shop, in which is the only American steam hammer in the Exhibition. It is made by the Morgan Engineering Co., and has the overhanging form of frame, the weight of the falling parts being 1,250 pounds, and the stroke 30″. The man in charge of the shop is enthusiastic about this hammer, and declares his belief that it is the best one ever built. He called my attention to a feature of the dies which he thinks is especially convenient, and which consists merely of an extension of the lower die for about 3″ beyond the upper die at one end. This enables scarfs to be made with great facility, and gives an excellent place to rest swages and other tools temporarily during the progress of the work, instead of removing them from place entirely, as would be necessary were it not for this place upon which they can be rested upon the lower die without being struck by the upper one. Though I do not remember having seen such dies in a steam hammer before, I think they have been used for scarfing in trip hammers, their advantage for this being in the fact that they keep the lower side of the work straight and smooth.

Nearest the AMERICAN MACHINIST desk in Machinery Hall is the tool display of Hill, Clarke & Co., of Boston and Chicago. In their space can be seen the universal grinder of Landis Brothers, which we illustrate this week; eight Flather lathes from 14″ to 22″ swing; a 26″ Mark Flather planer; an automatic cam cutting machine; four universal milling machines; 36″ and 48″ automatic gear cutters; six plain milling machines and a cutter grinder, all made by the Brainerd Milling Machine Co.; six upright drill presses, ranging from 20″ to 34″; five lathes, 12″ to 18″; and one radial drill press by Prentice Brothers, of Worcester; a 15″ turret lathe with automatic chuck by Bardons & Oliver, of Cleveland; 26″ lathe by the Gleason Tool Co., of Rochester; five cutting-off machines ranging in size from 2″ to 6″ by the Hurlbut-Rogers Machine Co., of South Sudbury, Mass.

Most of these tools have been fully illustrated and described in our columns, but there are a few points to which attention may be called. On one of the Flather lathes is shown a new method of applying the Slate taper attachment, by which great simplicity, convenience and efficient working are secured. An idea of how it is arranged may be gained from the sketch, Fig. 46, which is a plan view—not to scale nor pretending to be an accurate representation, but only sufficient to give the idea. In this sketch *a* is the taper guide bar which is mounted in the usual manner, but is adjusted by a spiral gear and pinion device with graduations on the hand-wheel by which it is very readily and accurately set. It has a sliding block *b*, which is fitted over it in the usual manner and attached by the connection *c* to a sliding block *d*, which is fitted over the cross slide in the same manner as the tool-rest. The cross-feed screw *e* is journaled in this block at the rear of the lathe and is secured in it by the nut seen at the rear end of the screw. Instead of the cross-feed crank handle being keyed directly to the screw it is keyed to the reduced outer end of the sleeve or quill *f*, within which the forward end of the cross feed screw is free to slide forward and back, but must turn with the sleeve because driven by a feather. It will be perceived that by this arrangement no extra slide is required nor an extra rod or connection reaching from front to back. The tool can be at all times moved by the cross-feed screw in the usual manner, whether turning taper or not. The rod *g* and the screw *h*, which pass through lugs on the block *d* and the tool rest, are used to take up all lost motion in case this is desirable, and when the taper attachment is not in use the block *d* is clamped to the cross-slide.

The 22″ lathe is of a new pattern—heavy and powerful, and instead of the usual three-stepped feed cones this lathe has plain pulleys for the feed belt and three pairs of gears inside the head for driving the stud, connection being made with either pair by a "push and pull pin," with shifting key to give the changes of feed, this change being also applicable as well to the gears for screw-cutting.

Amongst the Brainerd milling machines spoken of are some of unusual size and weight, one of these, a plain machine, being capable of taking a cut $\frac{1}{16}$″ deep, 14″ wide, at the rate of 14″ per minute in cast-iron. Another plain machine with overhanging arm has a platen 78″ long with an automatic feed of 72″, the weight of the machine being 8,000 pounds. This machine has a vertical spindle attachment, and in connection with this there is a circular milling attachment which bolts to the platen and is in the form of a horizontal rotating platen upon which work can be secured and rotated by power feed while being milled. The work being done upon this is a grooved wheel of cast-iron, the wheel being reduced to size, faced on both sides of the rim and the groove milled in the face at one cut.

The form of vise which goes with this machine seems to have merits of its own. It consists of two jaws which can be clamped anywhere on the platen by means of bolts which engage the T-slots, and with one of these is a movable jaw which is moved up to clamp the work by the usual set screws. In other words the vise is just like those ordinarily used except that the platen is used for the bottom of the vise and both the jaws can be placed at any point upon it, which in this case means that the vise can be instantly adjusted to take work of any size from ¼″ to 5 feet, and the work is always as near the platen as it can be placed.

The Gleason lathe has two different ratios of back gearing, the changes being made by sliding the larger gears upon the quill, and the feed gears are thrown out of action when desired by sliding the stud outwards to disengage the gears that drive it. The back gear lever has a spring latch which keeps the gears in their proper position; there is a thread indicator which shows when to close the nut to catch the threads properly, this being the well-known worm-wheel device engaging with the lead-screw, and the engagement of the lead-screw nut at the same time that the carriage feed is engaged is prevented by the device shown in Fig. 47, where *a* is the lever by which the feed is reversed within the apron, its middle position, as shown, disconnecting the gears entirely. Upon the stud which closes the lead-screw nut behind the lever is the collar *b* which turns with the lever, and both *a* and *b* have sections cut out of them in the form shown.* It will be seen that in the position in which they stand the lathesman can take his choice of the feeds he will use, but if he throws either one in he cannot throw in the other one until the first one is thrown out. This device is outside the apron, and though there are a number of lathes built which have devices for preventing both feeds from being thrown in at the same time, this is the only one I have ever seen where the lathesman who is possessed of an insane desire to get in all the feeds possible at one time can have the satisfaction of sitting down and studying out the reason why he cannot accomplish his object.

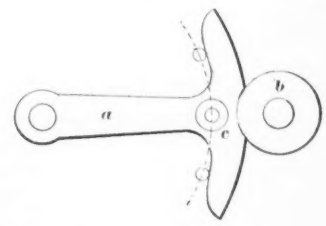
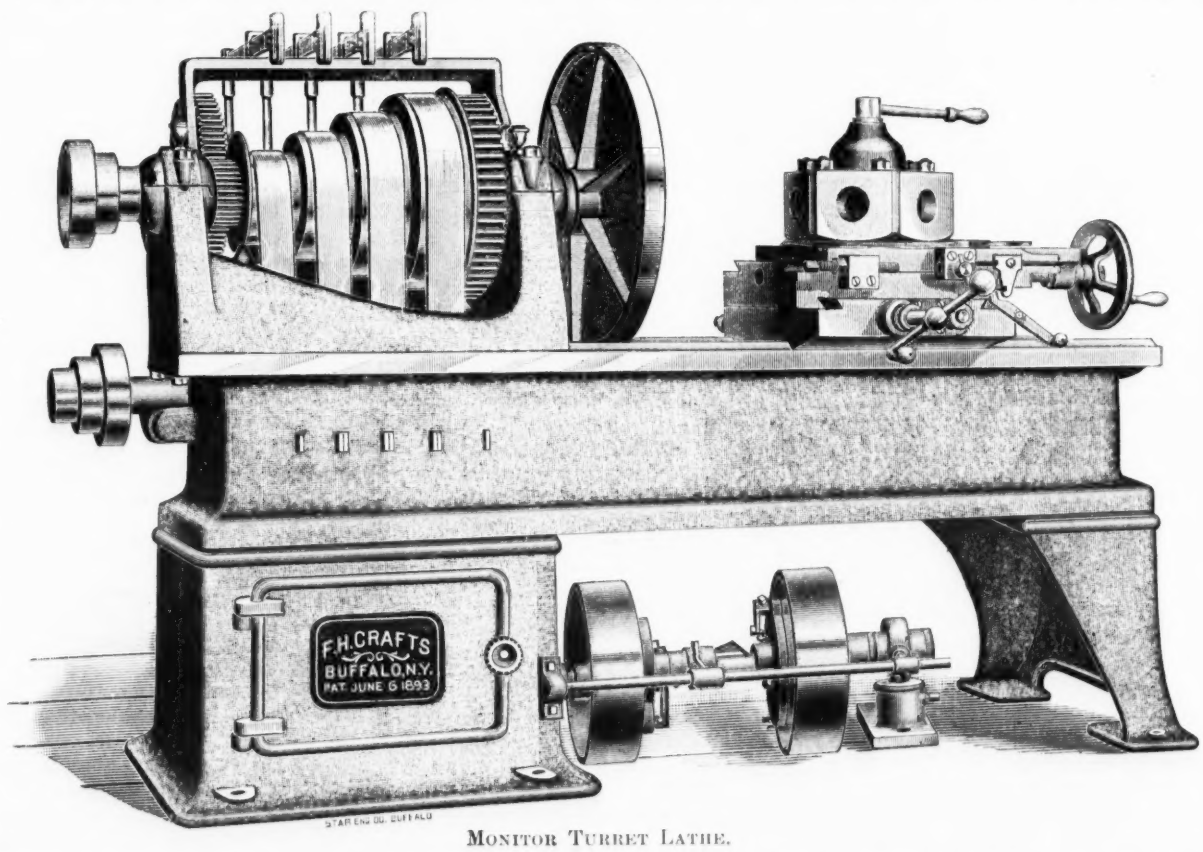


Fig. 47

Near by is the exhibit of the Hendey Machine Co., of Torrington, Conn., which includes three shapers of various styles and ranging in size from 15″ to 25″; three planers, the smallest a 10″x10″ power or hand machine, and the largest 27″x27″; a 14″ engine lathe of the regular Hendey pattern and three of the new Norton lathes, which we illustrated and described in our issue of March 23, the sizes shown being 14″, 16″ and 18″. It will be remembered that this lathe affords three methods of running the carriage back in cutting screws, *i. e.*, there is a carriage reverse like that used years ago on the Ames lathe; the nut may be opened and the carriage run back by hand, or the lathe may be reversed in the usual manner. But this seemed to be not quite enough for some of the visitors to the space who commented upon the fact that when the screw and carriage only are reversed the backward motion is no faster than the forward motion. The man in charge therefore put two open belts upon one of the lathes, and when any one wants to see the carriage go back rapidly without reversing the lathe he simply throws the clutch over into the faster motion while running the carriage back.

F. J. M.

Jackson Park, July 17.



MONITOR TURRET LATHE.

Monitor Turret Lathe.

In our issue of June 1 we illustrated a lathe built by F. H. Crafts, of the Buffalo Wood-working Machine Company, Buffalo, N. Y., the most noticeable feature of which was in the driving arrangement, in which an endless belt for each speed, controlled by means of a tightener, is employed. With this we show a turret lathe in which the spindle is driven in the same manner. As will be seen, the turret is hexagonal in form, having six holes for tools. The spindle has a 1¾-inch hole through it, and runs in carbonized phosphor-bronze boxes. The countershaft has friction pulleys 14 inches diameter and 6-inch face. Weight of machine about 5,000 pounds.

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* The engraver has not shown this completely but it will be understood from the text.

The New Mercury Column at the University of Illinois.*

Two objects were in view in improving the mercury column as described below. First, to substitute for the slow and irregular action of the hand pump some automatic means for producing a continuous and easily regulated pressure. Second, to provide an attachment for testing steam-engine indicators by direct steam pressure measured by the mercury column. Both these ends have been accomplished with entire success; a very rapid, or an exceedingly gradual rise in pressure up to 200 pounds can be automatically obtained with perfect ease, and the indicator attachments are found to be in every way an improvement on the means commonly used. The apparatus was designed by Professor Scribner, and has been constructed under his supervision.

In using it the weight of a column of mercury is balanced against the elasticity of the spring of the steam gauge or indicator, and the pressure thus acting on the spring is computed from the measured height of the mercury.

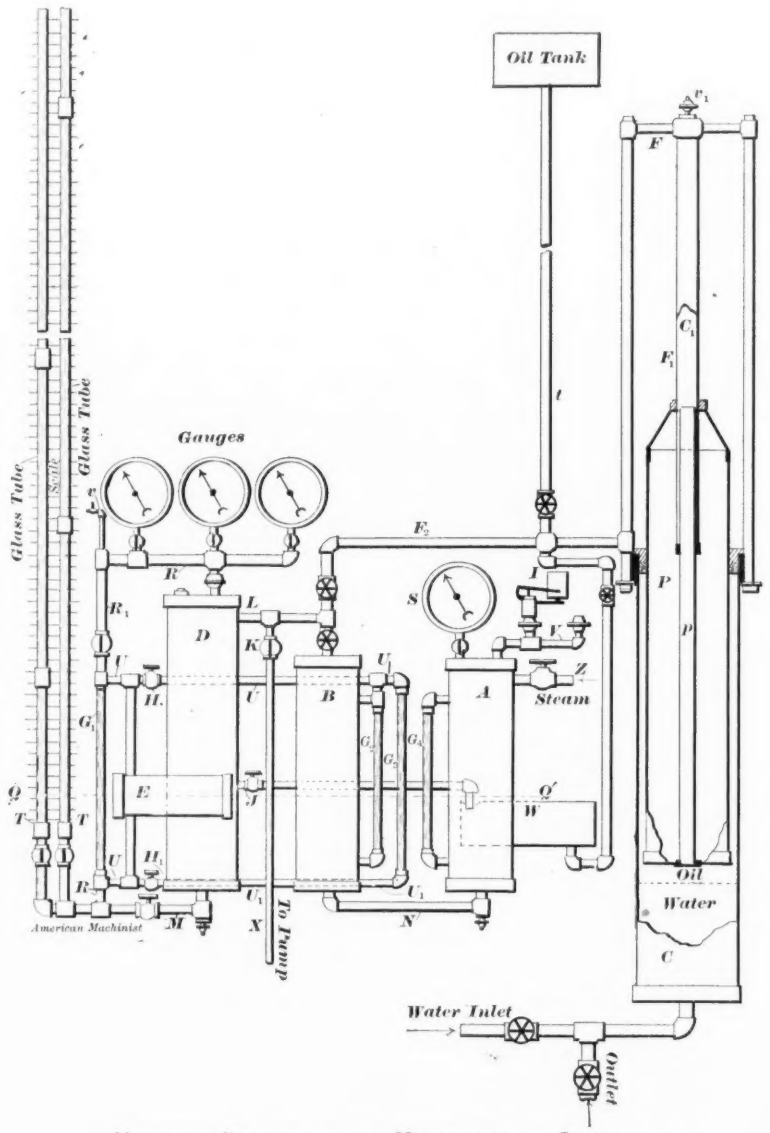
Pressure can be applied by the small hand pump, which forces oil in through the pipe X, also by steam through the pipe Z, or by the hydraulic apparatus shown at C, the working of which will be described later. In whichever way the pressure is applied, oil is forced through the pipe L into the cylinder D. The lower part of this cylinder contains mercury, which the oil forces out through the pipe M into the glass tubes $T\ T$ forming the column. The height to which the mercury rises depends upon the pressure applied to the oil. The tubes $T\ T$ are made of heavy glass, in 6-foot lengths, and behind them is a scale divided into inches and running the full length of the tubes. The joints in the tubes are at different levels, so that the height of the mercury can always be read in one tube when it is hidden by the joint in the other. To find the pressure due to the mercury, its height in inches above the zero mark is multiplied by the weight of a cubic inch of mercury at the observed temperature. This gives the pressure in pounds per square inch. The weight of a cubic inch of mercury at 60° F. is 0.491174 pounds.

The gauges to be tested are screwed to cocks on the pipe R. This pipe is connected to the vertical pipe R_1, which runs downward and connects to the pipe M containing mercury under pressure; a glass gauge tube G_1 forms part of the pipe R_1. Two pipes, U and U_1, branch off from R_1 just above and below the glass part G_1, and from these, two other pipes connect to the top and bottom of the horizontal cylinder E, the pipes U and U_1 continue on to the right to another glass gauge tube G_3. Thus the two glass gauges G_1 and G_3 and the cylinder E are so connected that when they are filled up to about the middle of E with mercury, and from that point to the top of R_1 with oil, the line between the oil and mercury will be at the same level in all three. The cock in the pipe from the top of the cylinder D to the pipe R is only opened to fill R, G_1, E, etc., with oil at the start, and *must be kept closed* at all other times. The cocks H and H_2 can be closed so as to shut off the tube G_3, and this is done in testing gauges. If the vent cock v in the top of the pipe R_1 be opened, and oil forced into the cylinder D, mercury will rise into the tubes $T\ T$ and G_1 and the cylinder E. At first it will rise rapidly, but after it gets up to about the center of E it will rise very slowly, on account of the large volume of E which has to be filled for a slight rise in height. The vent cock v in top of R_1 is now closed, so that the only way for the mercury to rise further in G_1 and E is by forcing oil into, and thus expanding the springs in the gauges. Of course this expansion will require very little oil, and as a proportionately large quantity of oil is forced out of E for a slight rise of the mercury, the level of the mercury in G_2 and E will now be practically constant. It will be readily seen that the cylinder E acts just as if it were a large bulb blown in G_1 at that level.

The zero of the scale is taken at the level at which the mercury in $T\ T$ stood, when the vent cock v was closed. Since this cock is at the same level as the centers of the gauges, the level of the mercury in $T\ T$ will be just enough above that in E, as shown by the gauge glass G_1, to balance the height of the oil up to the gauge centers.

To test steam engine indicators accurately, the test must be made with the indicator at the temperature it has when in use. Many schemes have been devised for doing this, but the best way is to use steam in the indicator at the desired pressure. When this apparatus is used for testing indicators the cylinders A and B are used in connection with the part already described. These cylinders are connected at the bottom by the pipe N, and each has a glass tube, G_2 and G_4, on its side to show the level of the water with which each is about half filled. The space in A above the water is filled with steam, which is admitted through the pipe Z, and that above the water in B is filled with oil. When the cock H is opened the oil in B can pass through a connection between the glass tube G_2 and the pipe U, and on through into G_1 and E. The valve in the pipe from the top of B to L *must be kept closed* when testing indicators.

The indicator I is attached to the pipe V, at the top of the cylinder A, a steam gauge S being also connected to this cylinder. This gauge must be known to agree with one on the pipe R. Before testing the indicator the water levels in A and B, as shown by their gauge glasses, must be made to agree with each other and with the mercury level in E, which should be halfway up in the latter and can be read both at G_1 and G_3. For this purpose the cocks H and H_1, in the pipes U and U_1, are opened and mercury in G_3 and the water in G_2 and G are adjusted to the same level Q–Q', near the center line of the cylinder E. The cocks H and H_1 are now closed and oil is forced into D and steam let into A until the desired pressure is reached. When the gauges on A and R read alike the cocks and H and H_1 are opened, and any slight difference in pressure is at once equalized. If the levels of the water and mercury in G_2, G_3 and G_4 have changed slightly, they can be adjusted. A line is now drawn on the card by the indicator, and the mercury column is read from Q as zero; the pressures thus represented are afterward compared to find the accuracy of the indicator. This process is to be repeated, at intervals of a few pounds pressure, throughout the whole range of the indicator spring.



MERCURY COLUMN AT THE UNIVERSITY OF ILLINOIS.

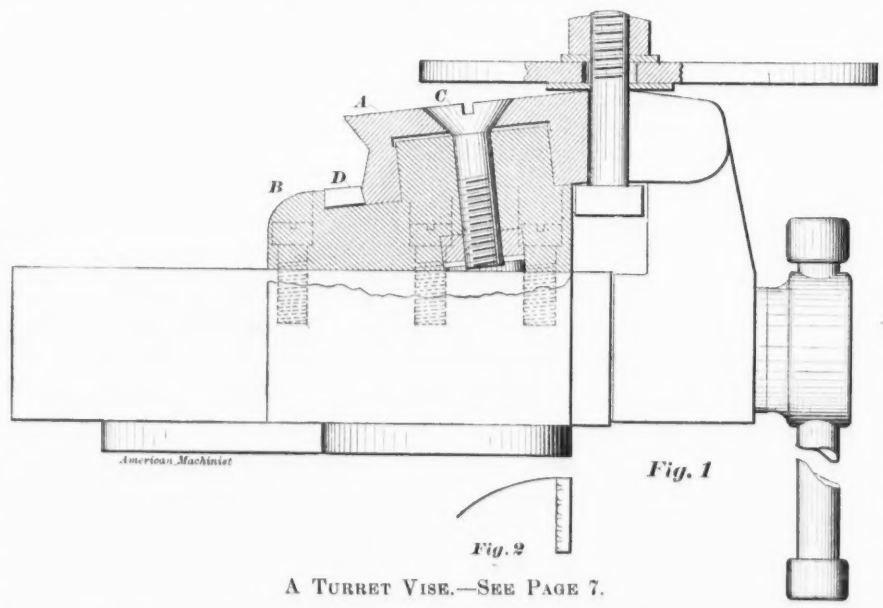


Fig. 1

Fig. 2

A TURRET VISE.—SEE PAGE 7.

A great advantage of this process is that no constant need be added to or subtracted from the height of the mercury column as read on the scale, provided, of course, the zero of the scale is at the same level as the mercury in G_2. This comes from the fact that the water in A and B, and the mercury in E, all have the same level, as shown by the gauge glasses G_2, G_3 and G_4. From this the water pressures in A and B balance each other, the oil in B balances that in E, and the mercury in E balances that below the same level in $T\ T$. The weight of the oil in the pipe R_1 will make a little difference in the reading of the gauges, but this does not enter into the result in testing indicators. As previously explained, it is allowed for in testing gauges.

These tests, for both gauges and indicators, should be made both with increasing and decreasing pressures to eliminate any friction errors in the instruments tested.

To use steam for producing pressure on the oil, the cocks H and H_1 must be closed, and the valve in the top of B opened. Steam is now let into A, and it forces water over into B; this drives the oil up and out of B and over into D, after which the effect is the same as before. This method is suitable for gauge testing only.

The hydraulic apparatus shown at C is generally used for producing the pressure. All parts of it are within easy reach, and as the pressure can be regulated so nicely it is probably as convenient an arrangement as could be devised. It is nearly all made of iron pipe and pipe fittings, and about the only machine work done was in turning the large plunger P, which works in the cylinder C. Inside of P, and fastened to it at the bottom, is the small plunger p, which works in the small cylinder C_1. The areas of these plungers are as 20 to 1. The large cylinder can be filled with water from the city mains through the pipe in the bottom. Two valves in this pipe let the water flow in or out as desired. There are a few inches of oil on the water in this cylinder to keep the plunger from rusting when it is left out of the water. The small cylinder C_1 is filled with oil, as are the pipes F, F_1, F_2, etc., that open into it. When the large plunger is moved up the small plunger rises in the cylinder C_1, and forces the oil in C_1 out through the pipes F, F_1, etc., over into the cylinder D. The pipes F_1 and F form part of the frame of the machine. The large plunger is weighted to bring it down again when the water outlet in the bottom of the cylinder is opened. The pipe t connects F_2 with a small oil tank in the second story, so that the oil can be forced from the machine up into it, or the machine can be filled from it, as desired.

From the lower part of the oil level in D, the pipe J runs over to the open reservoir W. This affords a convenient method of lowering the oil pressure slightly without lowering the plunger. In case it is desired to lower the mercury column without lowering the plunger, the oil can be drawn off through the pipe J; this oil can afterwards be drawn up into the cylinder C_1 by opening the valve in the pipe from W to F_2 and lowering the plunger. Drip cocks are placed on the lowest parts of cylinders and pipes, so that they can be entirely emptied, and vent cocks on the highest parts let the air out when the cylinders are filled again.

Steel in Japan.

The Japanese Government has for some years past projected the establishment of a steel foundry. Up to the present there has been only one such foundry in Japan—

*By Chas. H. Trego, in *The Technograph*.

namely, that at Sakai in Izumi Province, which was established by Mr. Moriyama Moriyuki, ex-Director of the Osaka Mint, in 1889. The steel manufactured at the foundry is said to be of the best quality, but its proprietors have so little capital that they cannot extend the works. The original hope was to manufacture sufficient steel for the construction of men of-war and arms for the military and naval services, so as to dispense with the use of imported steel. Several Japanese noblemen have now taken up the matter, with the result that a foundry is now being built in Osaka for the Japan Steel Manufacturing Company, who are procuring the latest improved machinery, and propose to manufacture five different qualities of steel from native ore.—*Industries and Iron.*

LETTERS FROM PRACTICAL MEN.

A Vise Shield—A Turret Vise.

Editor American Machinist:

I want to add a little to the vise and vise shield question.

In your issue of June 29, Mr. Hardinge objects to any kind of a soft vise shield on account of the chips becoming imbedded in them, making them as liable to damage the work as the vise jaws themselves.

I have seen vises used with the teeth ground out of them, but even then leather shields were thought necessary on the nicest work. I believe if these shields are made cheap enough, there is no need of having trouble with them on account of chips or dirt, for when they come to that state it is time to renew the leather.

The most satisfactory way I have seen used for making these leather shields, is to make the leathers of pieces of leather belting and fasten them to tin shields, by pressing them over burrs or prongs formed upon the faces of the tin shields by punching holes with a blunt center punch from the back side.

These burrs will partly turn over in the leather, and will hold very well. Fig. 2 (page 6) is intended for a section of such a shield.

The smooth side of the leather should come against the burrs, for this side holds better than the other. I think a machinist's vise can be improved and should be.

I have thought it would be a good plan to make the steel faces of vise jaws removable, so that different shapes might be kept for different work, that is, a set of V jaws, also a set of flat, smooth ones, also a set of flat, rough ones, and perhaps quite a number of others. Thinking of the matter still further as to how it could best be done, I concluded that the turret vise shown in Fig. 1 (page 6) would fill the bill very well. This would allow of as many different shapes as a person would wish, I think, and at the same time be about as convenient as any other vise in other ways.

Fig. 1 shows a side view of the vise with a part of the stationary jaw broken away showing this part in section. The turret would be square of a size to correspond with the width of jaws required. Referring to Fig. 1, *A* is the turret, which should be made of steel and properly tempered all over. *B* is a casting which forms the top of the stationary jaw which is fastened to the lower part by the screws shown in dotted outline. Upon this casting is formed a hub, which enters a recess to fit in the turret, which serves as a pivot for the turret to revolve upon. The turret is held down by the bolt *C*, as shown, it being tapped into the casting and the check nut in the counterbore underneath. *D* represents the end of a taper key that is used to keep the turret from turning when the jaws should be kept parallel, but when holding taper work this key may be left out. I think I should have the sliding jaw with a smooth face, then have one smooth, one rough, and two faces upon turret with smooth V grooves. One smooth and one rough jaw would hold better than two smooth ones. One smooth jaw and one V would hold a round piece better than two flat ones.

In the jaws of this vise I show a piece held in a position for working upon in a way that may be new to many.

As will be seen, it is just simply a bolt held in the vise, over which the work is clamped with the nut. This makes a very convenient way of holding some kinds of work in a position to be well got at.

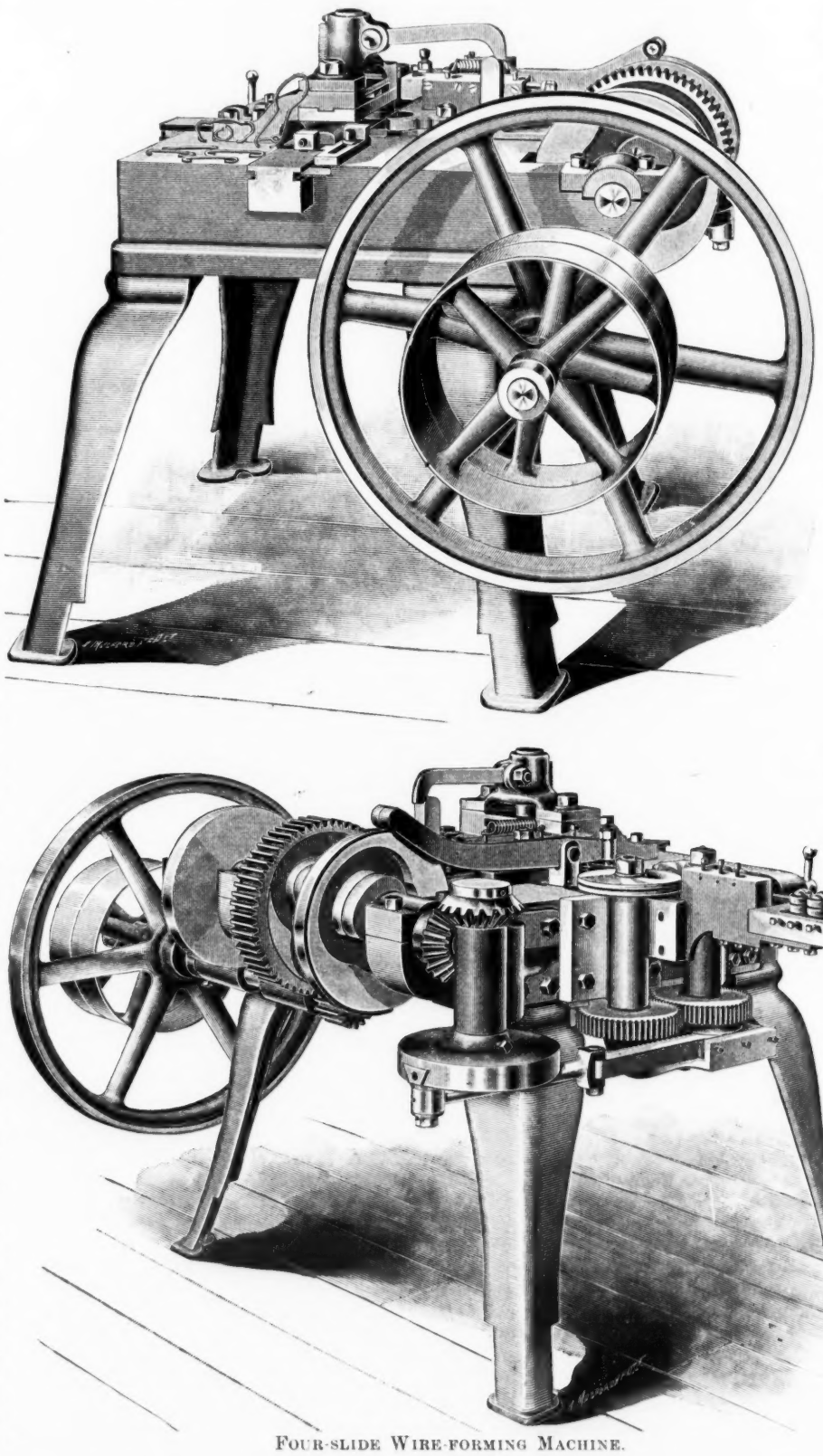
A MECHANIC.

Blue Printing or Printing with Salts of Iron.

Editor American Machinist:

I trust that a little elementary chemistry will not appear out of place in the columns of your well-known paper.

Undoubtedly most every reader of the AMERICAN MACHINIST knows what a blue-print is, and a large majority have made or used such prints; but there are very few that really understand the chemical action that takes place in making an ordinary blue-print.



FOUR-SLIDE WIRE-FORMING MACHINE.

I am quite sure that every reader of this paper will agree with me when I make the statement that the best results will always be obtained when the operator is quite well acquainted with the nature of the machine, or other elements, whatever they may be.

In considering the prussiate of potash we must not forget that we are dealing with two very different cyanogen derivates of iron, and that it is for this very reason that we are enabled to use the excellent process of copying tracings.

The first of the two compounds is potassium ferrocyanide (yellow prussiate of potash) $K4\ Fe\ Cy\ 6$. The second is potassium ferricyanide — $K6\ Fe2\ Cy\ 12$ (red prussiate of potash). The former cannot be used in blue-printing until it is converted from the ferrous to the ferric state by an oxidizing agent; this conversion is most conveniently effected by conducting chlorine into a solution of the ferro or yellow prussiate of potash. The ferrocyangen group, $Fe\ Cy\ 6$, is then changed to the ferric — $Fe2\ Cy\ 12$.

The red prussiate or ferric crystallizes out from water in red rhombic prisms. The free hydroferricyanic acid $H\ 6\ Fe2\ Cy\ 12$ is precipitated on the addition of hydrochloric acid with a ferrous solution, potassium ferricyanide affords a dark blue. This is Prussian blue—$K6\ Fe2\ Cy\ 12 + 3\ Fe\ SO4 = Fe2\ Cy\ 12 + 3\ K2\ SO4$. This blue is the ferrous salt of hydroferricyanic acid (this is the sediment that seems to perplex Mr. A. G. Robb in the issue of July the 6th AMERICAN MACHINIST).

All alkalies will convert it into ferricyanide of potassium and ferrous hydroxide: $K6\ Fe2\ Cy\ 12 + 6\ KOH = Fe2\ Cy\ 12\ K6 + 3\ Fe(OH)2$. This is the reason that one is enabled to write on blue-prints with lime water or a solution of lye.

When a ferric salt is exposed to the action of the sun's rays it becomes reduced to the ferrous state, and if this compound is treated with a solution of potassium ferricyanide a compound of Prussian blue is formed, while that part that is not "exposed" is still in the ferric state and is soluble in water and therefore washes out, while the ferrous is insoluble and forms the blue field.

There are a considerable number of methods of copying drawings, white lines on blue ground, blue lines on white ground, brown lines on white ground, and also the handsome black lines on white ground process, but the white lines on blue ground is by far the most simple and cheapest method of them all.

A. F. KEFFLO.

Thinks it in Bad Taste.

Editor American Machinist:

At bottom of page 8 and top of page 9, July 13 issue, is a notice of the advance of anthracite coal, which I think is in very bad taste. The Reading Railroad Co. own this coal and the hauling of it, and because they have tried to deliver it for less than cost the company is bankrupted, which is a calamity to every working machinist. If they had received 25 cents more per ton for all their coal they could pay their bills.

MOSES NEWTON.

An Error in Knight's American Mechanical Dictionary.

Editor American Machinist:

On page 1,234, Vol. 2, Knight's American Mechanical Dictionary, I find an error under the subject "Knitting Gauge." It is defined as "the number of loops contained in three inches of breadth." This is just double the gauge, the old English rule being gauge = number of needles in 1½", but is commonly spoken of as one-half the number of needles in 3", thus 24 gauge = 48 needles in 3", or 16 per inch.

CHAS. S. BEACH.

Of the 206 locomotives in use on Japanese railroads 200 were built in England, four in Germany and two in the United States.

Four-slide Wire-forming Machine.

The engravings represent an improved wire-forming machine for forming automatically various shapes of wire goods.

The bed-plate is 30 inches square and 7 inches in depth. The bed and bearings are cast in one piece, for strength and rigidity.

The shaft is of steel, 2¼ inches diameter, this single shaft carrying all cams and levers. On each side of the central gear are cams for operating the front and rear slide, and immediately on either side of these are cams for operating the side slides. The wearing cams are of cast steel, and provide for positive return; the slides are also of steel.

In operation the roll-feed feeds the wire from the reel, through the straightener, which cuts it off to the required length and the slides advance, bending it against a form corresponding to the desired inside shape of work; the slides then recede, and the finished work is forced from the form either by its own tendency to spring, or by the use of a stripper.

The machine has balance wheel 30 inches diameter, pulleys 16x4 inches, and is geared 4 to 1. It will take wire up to $\frac{8}{16}$ inch diameter, cut it to lengths from 1 to 15 inches, and form from 50 to 100 pieces per minute. The manufacturers are the Coulter & McKenzie Machine Company, Bridgeport, Conn.

It is said that manufacturers who send their goods to Brazil with catalogues made out in the language of the country and all weights and measures in the metrical system, have much greater success than those who persist in sending catalogues in the English language and adhering to the English system of weights and measures. Engineers will not take the trouble to convert the latter into the metric system, and without doing so there is no basis for comparison with the Belgian and French goods in favor there.

AMERICAN MACHINIST

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FRED J. MILLER, }

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

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NEW YORK, AUGUST 3, 1893.

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Headquarters at the Fair.

During the continuance of the Chicago Exposition the AMERICAN MACHINIST will have its headquarters in the space allotted to the Mechanical Press in Machinery Hall. The exact location is Section No. 27, Column K 37. Word can be left with the attendant there by any one who is desirous of meeting a representative of this paper, who may at the time be engaged elsewhere on the grounds.

Tests of Engines and Boilers at the World's Fair.

The judges on engines and boilers at the World's Fair have prepared memoranda of proposed tests, which we publish on another page of this issue. In this memoranda a plan is outlined, which, it is hoped by the judges, will be satisfactory to the exhibitors. In the interest of a better knowledge of the economic results of certain construction of both engines and boilers it is to be hoped that the tests may be arranged for, not for the purpose of instituting comparison between the engines and boilers of individual manufacturers, but between different types of engines and boilers and those of the same types materially modified in construction.

There are, however, possible difficulties in the way of such tests that will be no greater for looking at them fairly in the beginning. For example, individual exhibitors will be put to a very considerable expense in the matter; an expense that some of them may not feel like incurring. Perhaps they may all be willing to pay what will be required; if so, then this objection ceases.

The first part of one of the paragraphs of the memoranda reads as follows:

"It is agreed by the undersigned (jurors in classes 413 and 415) who are individually assigned to the various steam engines and boilers tested, that they will consider the results of the tests and use them if possible in formulating their reports."

This appears to imply that the awards will be influenced by the results of these tests. We do not know the exact terms of the contracts under which engines and boilers are exhibited. If such tests as the committee propose were specified in the contracts to be made at the expense of the exhibitors the latter can take no exceptions. If not, an exhibitor who is not willing, or able, to go to the expense of the tests as outlined can very reasonably object to having his refusal, or the effects of it, counted against him.

We hope that the possible objections we have referred to are without foundation, and that the tests will be made.

A Great Blunder.

The question of sewage disposal has long been a vital one in Chicago. Lake Michigan, the only adequate or practicable source of water supply, seeming to be also the only available receptacle for sewage. The Chicago river, which passes through the city, has been utilized to convey sewage to the lake, but the current in this river is, in ordinary times, so sluggish, that the water in it becomes unbearable, and when carried into the lake in unusual quantities by a freshet, it seriously pollutes the water supply.

To get over this trouble large centrifugal pumps have been used at Bridgeport, a point back of the city, for pumping the water out of this river and over a ridge to a point where it can flow away from the city, the pure water of the lake taking its place to that extent. These pumps were built at the Quintard Iron Works, New York, in 1884, and though somewhat crude perhaps, when compared with the best of such machinery as now built, were fairly satisfactory, and gave an actual efficiency of something over 50 per cent., computing from indicated horse-power.

By the growth of the city the amount of work that it became imperative to do became too great for the maximum capacity of these pumps and others were contracted for, these new pumps being constructed upon an entirely new principle and called the Courtright wave pumps. They were guaranteed to have 50 per cent. greater capacity than the old ones, instead of which it is said now that the old pumps have been taken out that the capacity of the new ones is only two-thirds that of the old ones, and that their highest efficiency is only about 34 per cent. reckoned from indicated horse-power, instead of being higher than that of the old ones, as was expected.

To make matters worse it was found, we are informed, during a recent expert test of the new pumps that they could not be run 24 hours continuously without a breakdown while the old pumps in being removed were seriously injured and perhaps ruined, the probability being that they cannot be again used.

It is probable that centrifugal pumps of the best construction, working under the conditions of low lift (about 4 feet to 5 feet) and with water filled with every form of impurity, are about the very best form of pumps that could be used for this service, and why, instead of supplementing those already in use by additional new ones, the authorities of Chicago preferred to throw the old ones out and put in pumps that were purely experimental, is one of those things that no one can understand—at least, no outsider.

In the meantime, the desperate condition in which the city finds itself may be inferred from the fact that the engineers making the tests found that articles of silver about their persons or their instruments rapidly turned black by the action of the atmosphere, grossly contaminated by the so-called water passing through the pumps.

What is to be done about this is, of course, not yet decided, the tests having been but recently completed; but it will probably be necessary to contract for and put in new pumps, which may possibly be done by early spring, while in the meantime the health of the city must inevitably suffer, and probably many deaths take place by reason of this colossal blunder.

Apparent and True Economy.

We have before alluded to the fact that engineers and mechanics need to know a good deal of human nature, as well as a good deal of mechanics and engineering, in order to do well.

There are men who have acquired, and others who are acquiring, the reputation of being "expensive men," *i. e.*, men who though they may know a good deal of their business do not know how to economize expenditures, and will bankrupt any concern with whom they may be connected, if allowed to have their own way long enough. Some of these men deserve such a reputation, while others that have it, or are getting it, do not deserve it, and get it only because they do not understand human nature and its management quite so well as some of those who know better how to make things appear all right to those whose money is being spent, but who are not capable of fully understanding the principle upon which it is spent.

A well-known engineer, upon taking the management of a large manufacturing establishment, the owners of which had made lots of money without much management, and because of the practical absence of competition, but who are beginning to feel the effects of the latter, laid out a plan which involved almost the entire reconstruction of the plant at a very great outlay, but kept quiet about this, and rearranged one thing at a time, reconstructing the tool room the first year, the foundry the next, and so on, until he had practically a new establishment, with every possible advantage for meeting the fiercest competition. He knew that if he began by talking of the necessity for changes which would involve the outlay of a million dollars or more, the first move towards it would probably not be made, but by doing one thing at a time, making each step show favorable results, saying nothing about the ultimate object, but keeping it steadily in view, he accomplished his purpose, and is to-day at the head of the best and most efficient plant for the purpose that is to be found, with full authority to introduce such further improvements as in his judgment may be advisable.

In a certain other line of manufacture there is one shop that is generally considered best fitted and equipped for work in that line, and it is altogether probable that good work is turned out there at a smaller cost than in any other similar establishment. This is the result almost entirely of the foresight, good management, and excellent engineering ability of its first manager, who was superseded because he was thought to be extravagant, while his successors, who carry out his ideas and reap the benefit of them, get the credit of being profitable men and good managers, which they really are, though they have never proved themselves to be possessed of the ability shown by the man who was the pioneer in the enterprise, and laid down the lines upon which its success has been attained.

There is a lesson in this for mechanics who may be called upon to manage affairs involving the expenditure of others' money. It should be remembered that there are usually other things to be looked after besides purely mechanical matters, and that the man who recognizes this, and gives some attention to those other features of the business, will usually come out best. It frequently happens that what is really the very best economy will inevitably appear to be wasteful extravagance to those who are not conversant with mechanical matters, or with the management of industrial affairs. In such a case it devolves upon the mechanic to not only know what good economy is, but so manage that others, ignorant of true economy in manufacturing, may not conceive the idea that money is being thrown away.

Those presumably familiar with the matter cite the New York Post-office as an example tending to show that government employes do not always have easy jobs and big pay. We have before this referred to what we believe from observation to be true, viz., the rather excessive hard work to which the letter carriers are subjected in New York, and not only this, but the advantage sought to be taken of them in the way of withholding pay for overtime. Now we are told that in many instances the clerks are overworked, and not only that, but rather poorly paid. There is no reason in the world why all government employes should not do a fair day's work at current pay, but there is no good reason why they should fare considerably worse in regard to both than the average employes of private parties or firms.

Different people have different ideas of saving. The Commissioner of Patents, for example, takes the lithographic work from one company whose experience in that work and facilities for executing it enabled it to do it promptly, the plea being that a saving of six to seven thousand dollars a year will be effected. The result is that the *Patent Office Gazette* is almost hopelessly behind in its issue, and patents that ought to be out are not, with no knowledge of when they will be. It is conceivable and altogether probable that the loss to patentees and to others interested in patents will exceed ten times the saving that has resulted in all this confusion. And this is called economy.

We noticed some time since the fight that citizens of Jersey City were making to compel the Erie Railroad to elevate its tracks through the city. They are still keeping up the fight, the latest move being to put men watching the trains, nearly all of which run faster within the city limits than allowed by law. It is believed that the outcome of this will be the arrest of a large number of engineers, the annoyance and cost falling, of course, on the railroad. The

best thing is to allow no grade crossings in a city; the next best thing is to abolish such as exist.

Tells You When to Carry an Umbrella.

The Albany Steam Trap Co., of Albany, N. Y., has sent us a pocket barometer or weather indicator about the size of a silver half dollar. It is very neat. Get one and try it. They write:

"Inclosed we hand you a pocket barometer, a sample of which we will be pleased to mail to our customers or engineering friends and steam users who will write for one mentioning AMERICAN MACHINIST."

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(378) A. M., Jeanerette, La., writes: Please inform me if a piston rod 2½ inches in diameter is large enough for an engine with a cylinder 20 inches diameter and 48 inches stroke; rate of speed, 40 revolutions per minute; steam pressure, 125 pounds per square inch. *A.*—In our opinion this piston rod is not strong enough; we should make it 3¼ inches in diameter.

(379) W. A B., Philadelphia, Pa., writes: Kindly inform me of the date on which the Atlantic was crossed in 14 days; also give name of steamship that made the passage. *A.*—It is difficult to answer your question, as the record of comparatively slow speeds is not complete. In 1839 the "Great Western" of England made a run from Liverpool to New York (3,017 miles) in 12 days and 18 hours.

(380) C. H. W., Worcester, Mass., writes: I would like to know how to cut a right-handed square thread, and a left-handed thread in a given distance on the same piece so as to produce an accurate transverse motion. *A.*—Cut the square thread first, and then set the tool so that it will finish the cut for the left-handed thread at a point opposite to the point at which the cut for the right-handed thread was commenced.

(381) C. A., Buffalo, N. Y., writes: Please answer the following: 1. What is it that makes hollow pistons burst when heated? *A.*—There are several causes for this; a hollow piston may burst through an unequal expansion of the metal; it may burst by expansion of air confined in the piston, or by the gas formed from the liquid which has leaked into it. 2. Should the center in a horizontal milling machine that supports the cutter arbor, similar to a lathe center, be hardened? *A.*—Yes. 3. How many articles on the "Cultivation of the Inventive Capacity," by L. Allen, have been published in the AMERICAN MACHINIST? *A.*—Eighteen.

(382) R. K., Brooklyn, N. Y., writes: Please give the size of an upright boiler for an engine with a cylinder 1½ inch diameter and 1½ inch stroke. I would like to use 1 inch flues in the boiler if possible. *A.*—For so small an engine you will not need any flues excepting one for the escape of the gases. We should recommend a type of boiler as illustrated in our issue of March 27, 1890, of the following dimensions: fire-box, 9½ inches diameter inside; height of fire-box, 16 inches; outside diameter of boiler, 14½ inches; total height of boiler, 28 inches; diameter of flue, 3¼ inches inside.

(383) H. P., St. Louis, Mo., writes: In my line of work I am sometimes called upon to make a perspective drawing of a machine, and being unable to secure a photograph must lay it out according to the rules of perspective. Can you inform me of any shorter or easier method of drawing the outline, etc., of a machine, or is there any such method; and how do engravers lay out their original drawing in perspective? *A.*—The most correct way is, of course, to work according to the rules of perspective. But after you have had some practice all you will need is the correct location of the principal center lines and points, and then sketch in the rest by eye. Engravers generally sketch the whole machine without referring to the rules of perspective; their extensive practice enables them to make good pictures and sufficiently correct for all practical purposes.

(384) M. M., Pittsburgh, Pa., writes: I shall feel thankful if you will give me some information on the following subject: I am a resident of Pittsburgh and I am anxious of taking out a stationary engineer's license; can I go in for examination in this city, and, if so, at what place? *A.*—We do not know what the rules and regulations are in Pittsburgh; in New York City the applicants for a stationary engineer's license have to apply at the police headquarters; in your city you may have to apply also at the police headquarters—anyhow it will do no harm to inquire there. 2. If I want to apply for a marine engineer's license must I go to a seaport to be examined? *A.*—We believe it is not necessary to do so; however, we would advise you to write to George H. Starbuck, Supervising Inspector of Steam Vessels, New York City; he will take pleasure in giving you all the information you need. 3. If I am successful in obtaining a license can I enter the U. S Navy as an engineer? *A.*—No; you cannot enter the U. S. Navy as an engineer unless you are a graduate from the Naval Academy at Annapolis.

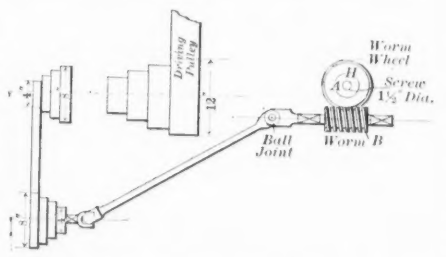
(385) H. M. D., Seneca Falls, N. Y., asks: How many horse-power can be transmitted by a 12-inch double leather belt? The driving pulley is 42 inches diameter and makes 140 revolutions per minute; the driven pulley is 36 inches diameter. Both pulleys have an iron rim, and are not covered. The distance between the centers of the pulleys is 13 feet; the driven pulley is above the driving pulley at a distance of 6 feet from the vertical line drawn through the center of the driving pulley to the center of the driven pulley. *A.*—The belt will transmit 36½ horse-power. We do not favor the position of the pulleys; it would be better to have a distance of 20 feet between the centers of pulleys; it is also desirable that the angle of the belt with the floor should not exceed 45 degrees, because when this angle is much increased, and the line drawn through, the centers of pulleys approaches a vertical position, the belt must be kept very tight to do the work, which increases the friction in the bearings, and causes a tendency to heat. If the pulleys must be placed in the position indicated, the belts should be carefully selected from well-stretched leather.

(386) E. J. B., Joliet, Ill., writes: Supposing I bore a pulley 66 inches diameter and 29 inches face, weighing 2,600 pounds; after turning it I find it 60 pounds out of balance. I now propose to re-bore it; how much shall I set it over to bring it in balance after the job is finished? *A.*—A pulley which is 60 pounds out of balance after it has been bored and turned, generally indicates that it has not been properly centered in the lathe. Under these conditions we should advise you to center the pulley in the lathe, so that the inside of the rim will run true as near as possible, and then re-bore and re-turn; if then the pulley is out of balance, it can be brought into balance in the usual way. You have probably set the pulley in the lathe so that the outside of the rim ran true, which frequently leaves the pulley out of balance; if on the other hand the pulley is set so that the inside of the rim runs true and then turned, the thickness of metal in the rim will be more uniform, and a better balance obtained. It is a very difficult matter to find the amount that the pulley has to be set over for re-boring so as to obtain a balance; we should advise you not to try it, as it may result in a complete failure.

(387) F. C. M., Paterson, N. J., writes: I have had a dispute with a friend in regard to the following question: Two locomotives are coupled together, each pulls 2,500 pounds, the engines pull in opposite directions, what force is exerted on the coupling? Please give explanation in full. *A.*—Under the above condition the pull or the force acting on the coupling bar will be 2,500 pounds. The reason for this is so plain that there is not much to be said in explanation, and we do not see any cause for dispute unless one of you has the erroneous idea that the pull on the coupling bar is 5,000 pounds. We mention this because we know others to have fallen into the same error. Assume that one of the engines is coupled to a train of cars too heavy for the engine to move it, and now suppose the engine is exerting a pull of 2,500 pounds, then the pull on the coupling bar will be 2,500 pounds, and if the coupling bar breaks, the fracture is due to the force of 2,500 pounds acting upon it, and no more. The engine is pulling against a resistance, and it makes no difference in the force acting along the coupling bar, whether the resistance is caused by a train of cars or by another engine pulling in an opposite direction. Take an analogous case: Suppose a spring balance is attached to a 50-pound weight and the weight is lifted by the spring balance, then the latter will indicate 50 pounds, no more or less. Here we have the force of gravity acting at one end of the balance with a force of 50 pounds, and a force of 50 pounds exerted by the person who lifts the weight at the other end of the balance, and yet the force acting on the spring, as it plainly indicates, is 50 pounds.

(388) J. E., Duluth, Minn., writes: Please explain how to read the following: P_1, P_2, P_3, P, P', P'', and P^1, P^2, P^3. I find them in analytical geometry, and am uncertain as to the proper reading of some of them, and completely in the dark as to the others. Perhaps there is something lacking in my previous studies. *A.*—Letters with a subscript placed after them as P_1, P_2, P_3, read P sub. 1, P sub. 2, P sub. 3. The subscripts are used to designate different quantities of the same kind; for instance, if P denotes a force, P_1 denotes another force greater or less than P, and P_2 would denote still another force greater or less than either one of the former. The use of subscripts is to some extent a matter of convenience, and besides this they also present the conditions of the problem in a more comprehensive manner; without the use of subscripts, a different letter would have to be used for each quantity or thing represented. The accents employed, as P', P'', P''', are used for the same purpose as the subscripts; the letters with accents read P prime, P second, P third. The indices placed above and at the right hand of the letters, as P^1, P^2, P^3, denote that the quantities which the letters represent must be raised to powers whose degree is indicated by the figure. Thus P^1 indicates the first power of P, P^2 indicates the second power or the square of P, P^3 indicates the third power or cube of P. These letters with the indices read, the first power of P, P square, P cube. Here we have given the mathematical significance only of these symbols. In describing machinery or other structures, any of these symbols, or all of them, as convenience may dictate, may be used simply for the purpose of designating parts.

(389) J. T. N., Buffalo, N. Y., writes: Please solve the following problem for me. The accompanying sketch gives all the necessary dimensions; it shows the feed gearing for a milling machine. What I want to do is to run the screw A so that one revolution will advance a table $\frac{1}{100}$ of an inch. The 12 inch driving pulley makes 200 revolutions, and the feed pulleys are placed as shown. What size worm wheel and worm, and what pitch and number of teeth will I require to get the desired result? The screw would be more satisfactory if its pitch is ¼ or ⅜ inch. *A.*—Your



question is somewhat indefinite, or, to say the least, it is not plainly stated. However, we shall assume that the screw A is connected direct to the carriage and that the latter is to advance $\frac{1}{100}$ of an inch while the *worm B* makes one revolution. Under these conditions we simply divide the pitch of the screw A by the desired advance of the carriage, the quotient will be the number of teeth in the worm wheel. If the pitch of the screw is ¼ inch, then we will require $\frac{.25}{.01} = 25$ teeth in the worm wheel. If the pitch of the screw is ½ inch, then we will require $\frac{.5}{.01} = 50$ teeth; or if the pitch of the screw is ⅜ inch, then $\frac{.375}{.01} = 37\frac{1}{2}$ teeth, but since we cannot use a fraction of a tooth we shall have to use 37 or 38 teeth; the former number will slightly increase the advance of the carriage; the latter will slightly decrease it. For determining the pitch of the worm wheel, we should know the amount of work the machine has to do, but we believe that 4 diametral pitch will answer your purpose; in this case the diameter of the pitch circle of the worm wheel will be 6¼ inches. The outside diameter of the worm we should make 4 inches. If you intend to advance the carriage $\frac{1}{100}$ of an inch while the 12-inch driving pulley makes one revolution and the belt is placed on the cone pulleys as shown, then it will be evident that the worm B will make ¼ of a revolution while the driving pulley makes one revolution. Under these conditions the worm wheel will require ¼ of the number of teeth as previously found. 2. If you think there can be any changes made in the size of pulleys that would benefit the machine, I shall be ever ready to accept them. *A.*—We cannot express an opinion in regard to this matter, as we do not know the kind of work the machine is designed for. As far as we can judge the diameters of pulleys are all right.

BUSINESS SPECIALS

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G. T. McLauthlin & Co., 120 Fulton St., Boston.

Air Compressors for every possible duty. Clayton Air Compressor Works, 43 Dey Street, N. Y.

For Cypress Tanks and Vats, address W. E. Caldwell Co., Floyd and Main Streets, Louisville, Ky.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt, Newark, N. J.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Most sensitive and durable Damper Regulator made; works within one pound. Send for circular. T. Kieley, 11 W. Thirteenth Street, New York.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

12-inch breech-loading rifled mortar & mounting, w'ght 118,000 lbs., front Gov't B'ld'g, World's Fair; des'n on applica'n. Builders Iron F'dry, Prov., R. I.

"Pumping Machinery." New book, 450 pp, 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton Avenue, Philadelphia, Pa.

Gear Cutters, Auto. Specially adapted for Motor Gears and all other style Gears.
Gould & Eberhardt, Newark, N. J.

Something new in name plates; "oxidized aluminum"; write for sample. Finest castings in the world, made by patent pressure process. Passaic Art Casting Co., 35 Warren St., New York.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
111 Broadway, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles the "Common Sense," as heretofore sold by us and mailed to any address at $1 00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Proposed Tests of Engines and Boilers at the World's Fair.

(*Continued from page 3.*)

judges. It is therefore proposed that the sub committee of judges whose names are subscribed hereto make through their Secretary a communication to each exhibitor interested in this matter, stating that they are prepared to make tests as outlined above, provided that each one contribute for the purpose such sums of money as may be necessary (beyond what the Exposition authorities provide) to arrange apparatus and make preparations for the test, and a further sum not less than $300 nor more than $500 for each engine or boiler, or for each series of tests, to cover expenses of the expert in charge of the work and his assistants. It is proposed that the tests be all made under the charge of Geo. H. Barrus, one of the judges on engines and boilers, who has agreed to devote his time to the work, and that the exhibitors interested be informed of this selection for expert. It is understood that at the conclusion of the entire work the results are to be fully reported in a form suitable for publication, and transmitted to the Secretary of the Jurors of Department F. (Machinery) for incorporation in the published report of the Executive Committee on Awards; and further, that the results obtained from the various exhibits tested be furnished to the respective exhibitors.

It is agreed by the undersigned (jurors in classes 413 and 415) who are individually assigned to the various steam engines and boilers tested, that they will consider the results of the tests and use them if possible in formulating their reports. It is further agreed that if any individual judge makes objections to the methods of testing, the kind of apparatus employed, or conclusions drawn from the results of the test of the engine or boiler assigned to him, he shall abide by the decision of a majority of the jurors in these classes regarding the matter in dispute, the majority being understood to refer to the jurors whose opinion can be ascertained in writing within five days of the date of making the complaint.

It is understood that the observers employed in the work of taking the data of the tests shall be members of the committee of jurors in the class to which the exhibit tested belongs, provided they are willing to devote their whole time to the work whenever it may be required. No assistant shall be in the employ of the exhibitors, either directly or indirectly.

IX.

In selecting the engines and boilers named above, which the committee of jurors consider it desirable to test, it is not intended that the tests shall necessarily be limited to those specified. Any exhibitor, who so desires, may have the engine, boiler, or other appliance which he exhibits subjected to test, provided that he pays the sum of money required for the preparations and the sum named above for services of the expert and his assistants.

J. E. Denton,
Geo. H. Barrus,
O. Emerson Smith,
R. C. Carpenter,
Louis E. Reber,
Carl Haller,
P. J. McMahon,
Prof. V. Kirpicheff,
Prof. W. C. Unwin.

Sub-Committee of Jurors of Group 69, Classes 413 and 415.

Chicago, Ill., July 21, 1893.

An Oil Box Pattern.

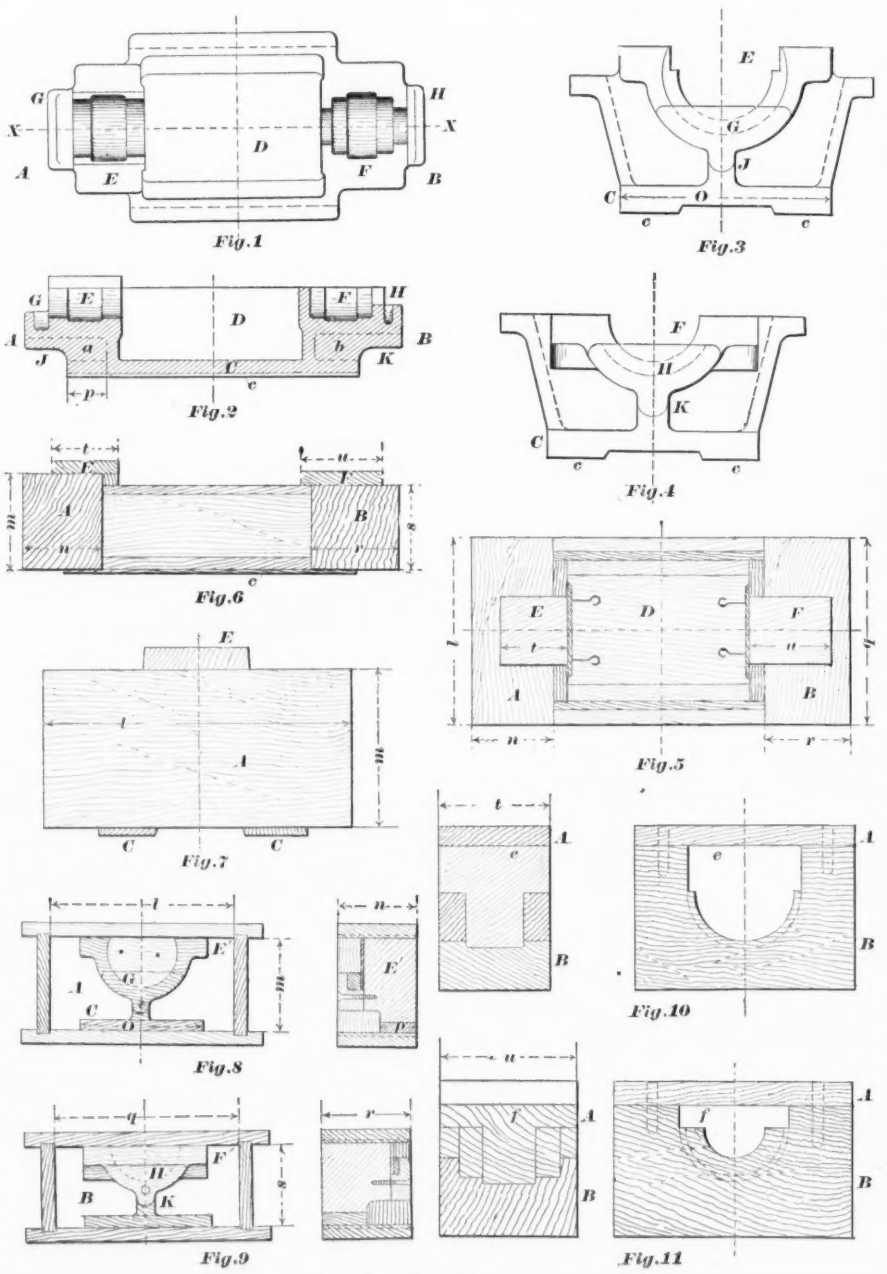
By Joseph Horner.

Figs. 1, 2, 3, 4 illustrate an oil box used for a worm employed in a piece of hoisting machinery. I describe it because it is a good example of coring out, nearly all the work being done in cores instead of in the pattern itself.

Fig. 1 is a plan view of the casting, Fig. 2 a section on the center line $X-X$, Fig. 3 an end view looking from A, and Fig. 4 an end view looking from B. In the figures, C is the foot of the oil box, with planing strips c; D is the oil receptacle, E F seatings for brass bearings, E being a common bearing, F a thrust bearing with collars in the shaft, and in the brasses (not shown). G H are receptacles for the waste oil, J K are bosses and ribs underneath the bearings, holes being drilled in the bosses and filled with plugs to let the waste oil out of G H.

Of course, in molding this box without cores the difficulty would be with the recessed ends a and b, which would not deliver whether the bearings E F or the planing strips c c were molded downwards. To draw these ends inwards would necessitate an open space at D, and consequently a core, and then the recesses of the waste oil cups G and H would also have to be cored out. So the entire ends A and B and the entire bearings E F were taken out with cores. Figs. 5, 6 and 7 illustrate the pattern in plan, elevation and end view respectively, from which it is seen that beyond the actual box itself, the portion D and the planing strip c, the pattern bears no resemblance to the castings; but that prints A, B, E, F are substituted for those portions of the casting similarly lettered in Figs. 1–4. A comparison of the groups of figures will render the relationship of these parts clear, and the timber shading illustrates sufficiently the construction of the pattern. The core boxes are shown in Figs. 8–11. Fig. 8 cores out the end A in Fig. 2, Fig. 9 the end B, Fig. 10 the bearing E, Fig. 11 the bearing F. In Fig. 8 the framing of the box is made in the usual way, with ends grooved into sides. The inner dimensions of the box correspond with the dimensions of the print similarly lettered in Fig. 8, and in Figs. 5, 6 and 7—the length l, the breadth n and the depth m. In the box are fitted that portion of the foot C in Figs. 1–4, of length O, and breadth p, the bearing block E', with facing corresponding with that on E in Figs. 1–3, minus the hollow seating for the brasses, and the waste oil cup G.

Fig. 9 shows the core box for the end B of the casting. Its length q, breadth r and depth s correspond with the dimensions similarly lettered in Figs. 5–7, and it is fitted with a portion of the foot, the bearing block F', waste oil cup H, and boss and rib K. In both core boxes the oil cups are left loose, being held with one screw only during ramming, so that the oil recess shall deliver itself instead of being made in another core.



An Oil Box Pattern.

Fig. 10 is the core box for taking out the hollow bearing recess E in Figs. 1 and 2, the portion e fitting into the print E in Figs. 5 and 6. Its width t corresponds with t in Figs. 5 and 6. Fig. 11 takes out the recess F in Figs. 1 and 2, the portion f fitting into the print F in Figs. 5 and 6. In Figs. 10 and 11 the pieces A A are doweled upon the bodies B of the boxes, being removed after ramming for the removal of the cores.

The timber shading in all the figures renders the method of construction of the several parts apparent, and renders detailed description unnecessary.

The total attendance for the month of May, 1889, at the Paris Exposition, was 2,610,813.

An explosion occurred recently in a coal mine in England by which 140 lives were lost.

Compressed Air and the Way it is Wasted.

By Frank Richards.

It has often occurred to me that the position of compressed air before the general public that is interested in mechanical matters is a peculiarly friendless and unprotected one. As a means of power transmission its commercial position is strikingly different from that of electricity, and in every way the difference is to the disadvantage of the compressed air. The application of electricity calls for more or less of special technical knowledge, and consequently any electrical plant in its initiation and through all the stages of its installation and in its permanent management is under the control of experts with the technical knowledge and training required. The electrical plant is usually all new, and is put in as a whole. The one part is proportioned and adapted to the other part and to the results to be accomplished, and the results are reported in the best possible form by the same experts who have the looking after it all the way through. This, as far as electricity is concerned, is all as it should be. There is nothing of injustice about it. It means merely that electricity in its commercial relations looks out for fair play for itself, and gets it.

But compressed air has no all-around friend to look after its interests, to see that it has fair play, and that its achievements are duly heralded. While any of the electrical companies are fully equipped to look after every detail in the economical generation and application, and in the world-wide advertisement of electricity, there is no company, notwithstanding the extensive and ever-widening use of compressed air, that even attempts or proposes to cover the field both of its generation and of its distribution, and to look after its interests in general. The three or four companies who are building most of the air compressors in this country have their hands full without troubling themselves much about how the compressed air is used. And, in the popular view of it, why should they? There is nothing special to know about compressed air, you know. It is easier to understand and to handle than steam is, and everybody knows all about steam. There is nothing dangerous about it as there is with electricity to deter the uninitiated from tampering with it, so no one need make it his special business to look after it. Nevertheless it would seem that there is money in it for somebody.

The first and principal demand for air compressors thus far, and what has built up the business of their manufacture, has been to supply the compressed air for rock-drills and mining machinery. The rock-drill, whether driven by steam or air, makes no pretensions to economy in the use of the motor fluid, and, like a sailboat, its performance can only be compared with that of another under similar conditions and can never be accurately measured, and the performance in the individual case will then depend largely upon the skill of the operator.

With the compressed air supply at hand in the mine, the most obvious use for it, after the rock-drills are provided for, is for driving the pumps. The status of the pump is very different from that of the rock-drill, in that it is always possible to measure very closely the work that is done. In practice the measuring is usually a matter of hindsight rather than of foresight. It usually comes in for the purpose of finding fault with the results accomplished, instead of for determining and securing beforehand the most economical conditions. A pump is a pump, anyway, and if a pump will only pump, what more is there to look out for? But the common direct-acting steam pump, with its large waste spaces to be filled, and without the slightest pretense of using the steam or air expansively, has still the faculty of doing worse under some conditions than under others. How badly it can do I am unable to say, because this is one of these cases where the practice can easily outstrip the theory. I can more easily show some conditions under which it can be expected to do nearly as well as possible, and some other conditions where we can say that it will not do as well. Say that we have an air compressor, such as those in general use, with the air cylinder 20″ diameter x24″ stroke x75 revolutions per minute, and compressing to 35 pounds gauge pressure. The power required will be about like this:

$20^2 \times .7854 \times 21.6 \times 300 \div 144 = 61.69$
+ 10 per cent. = 67.86 horse-power.

The free air capacity will be

$20^2 \times .7854 \times 300 \div 144 = 654.5 - 10$ per cent. = 589.05.

Say that we use this air in the steam cylinder of a common steam pump. The available air will be

589.05 cubic feet free air × .3289 = 193 94 cubic feet air at 30 pounds gauge.

A pump cylinder 16″ diameter x1 foot stroke x111 single strokes per minute will just about take this:

$16^2 \times .7854 \times 111 \div 144 = 154.98 + 25$ per cent. = 193.7 cubic feet.

The power realized will be

$16^2 \times .7854 \times 30 \times 111 \div 33{,}000 = 20.29 - 10$ per cent. = 18.26 horse-power.

Comparing this with the power required by the air compressor above, we have

18.26 ÷ 67.86 = .269 the power realized.

Say now that with the same compressor at the same speed we compress the air to 80 pounds. The power required will then be

$20^2 \times .7854 \times 36.6 \times 300 \div 33{,}000 = 104.5$
+ 10 per cent. = 114.95 horse power.

If we use the air in a pump at 75 pounds the available air will be, the free air being the same as before,

589.05 × .1639 = 96 54 cubic feet at 75 pounds.

A steam pump with cylinder 12″x1 foot stroke x98 single strokes per minute and the same allowances as before, will take all of this air:

$12^2 \times .7854 \times 98 \div 144 = 76.96 + 25$ per cent. $= 96.2$.

In this case the power realized will be

$12^2 \times .7854 \times 75 \times 98 \div 33{,}000 = 25.19 - 10$ per cent. $= 22.67$.

Comparing as before with the power required by the compressor, we have

$$22.67 \div 114.95 = .197,$$

which is decidedly lower than was realized when using the air at the lower pressure.

This shows, as experience shows, that with no effective means of cooling the air during compression, and with no means of heating the air before using, it is better to use low pressures. The apparent advantage will be modified by the consideration that larger cylinders must be employed both for the compression and for the work to be done, and also that larger air pipes must be used, or additional loss encountered from the friction of the air in the pipes if transmitted for long distances.

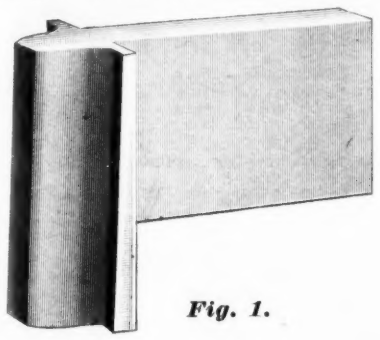


Fig. 1.

A worse showing than the above is often encountered in practice where air is carried at say 80 pounds to drive rock-drills, and the same air supply is used to drive pumps that require a much lower pressure, say 25 or 30 pounds. In this case the use of the lower pressure is a mistake.

Taking, as above, the compressor working to 80 pounds, and the air delivered for use at 75 pounds, the 96.54 cubic feet at 75 pounds, and at 60° temperature, if expanded without loss or gain of heat to 30 pounds before its use in the pump, will become 157.97 cubic feet at — 30°. This assumes that the air is carried at the higher pressure to the throttle valve of the pump, and that the expansion and cooling takes place after passing the throttle.

Here we have 157.97 at 30 pounds instead of 193.94 that we had before. Then:

$$137.97 \div 193.94 = .711,$$

and at the same time the power required to compress has been as above, 114.95 instead of 67.86. Then:

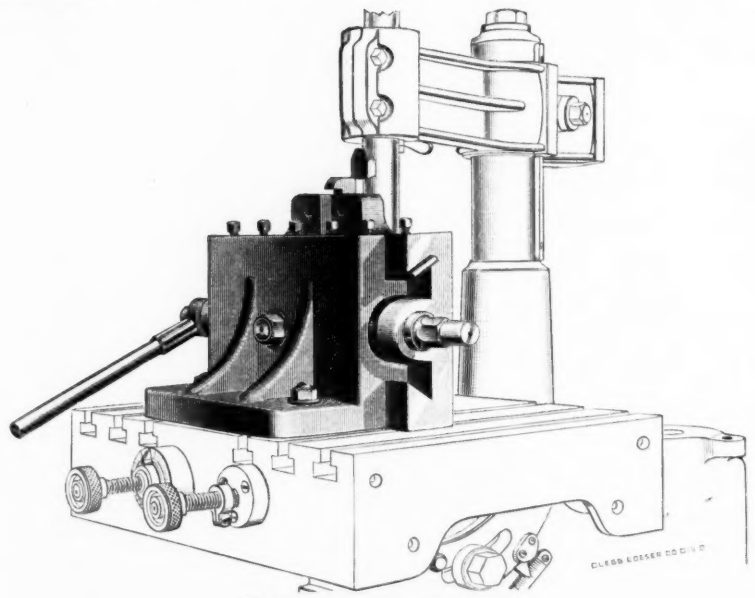
$$67.86 \div 114.95 \times .711 = .419.$$

While above in using air at 30 pounds we realized .269 of the power employed, in this case we realize:

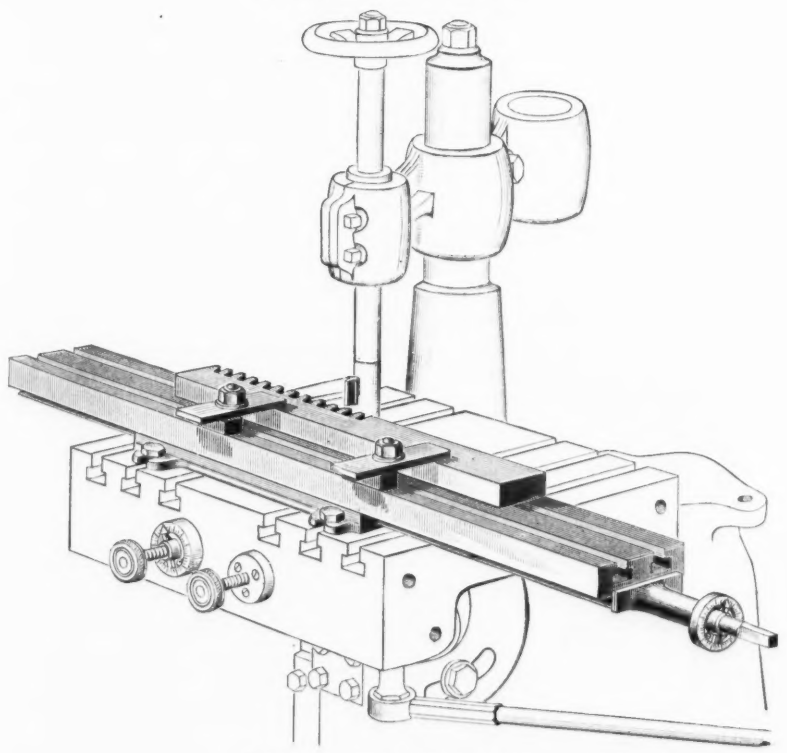
$$.269 \times .419 = .1127.$$

And even then the complaint will not be about the waste of power. It will be that the pump freezes up and won't go.

Probably next to its use for pumping, the most prominent use of compressed air is for hoisting. Where air is used for hoisting, it is not so used because it is absolutely the most economical application of power, the power alone being considered, but because in its quickness and convenience it effects a substantial saving in time and in manual labor. The travel of the hoist for any given lift is not usually coincident with the length of the air cylinder, so that for every lift there is a greater or less portion of the cylinder filled for nothing. This seems to be unavoidable, except in cases where the lift is constant, when of course the cylinder may be made and the connections adjusted to correspond with the duty required.



KEY-MAKING ATTACHMENT.



RACK-CUTTING ATTACHMENT.

I was surprised to see in the AMERICAN MACHINIST, June 22, the description of the hoist in use at the Armour Packing Co.'s packing house at Kansas City. In the hoist as represented the compressed air is used to return the piston the same as for the hoisting.

The consequence is that while for the hoisting only sufficient air is admitted to lift the weight the distance required, the air to return the piston when admitted to the other end of the cylinder is not shut off until that end is filled with air at the full reservoir pressure, and more air is used for the lowering than for the hoisting. It is not clear why the inventor, who should wish to make as good a showing of the hoist as possible, should have published it in this form, for while the hoist was designed as described it was, as a matter of fact, changed afterwards, and is not now so used. A three-way valve was substituted for the four-way valve and the back cylinder head was taken off so that no air pressure is now used for the return of the piston.

Compressed air loses more or less, as everybody else is apt to, on account of its modesty. When any leakages occur it does not announce them with the bluster that steam puts on. There is no visible cloud of vapor, there is no puddle of water and there is little noise, so that a leak may easily escape detection, yet it is possible enough to have the pipes and connections "bottle tight." How important it is and how much may be saved by attention to this may perhaps be realized when we consider that with air at 80 pounds gauge pressure a $\frac{1}{16}''$ hole will discharge more than five cubic feet of free air per minute. Referring to my table in the AMERICAN MACHINIST, March 30, we find that to compress one cubic foot of free air to 80 pounds gauge pressure requires .19521 (or nearly one-fifth) horse-power, so that a $\frac{1}{16}''$ hole leaking industriously will get away with a full horse-power.

Attachments for Keyway Cutting Machine.

In our issue of July 6 we illustrated the keyway cutter made by Baker Brothers, Toledo, O. With this we show two attachments for this machine—one for planing keys and the other for cutting racks. In planing a key it is held vertically in the chuck (as shown in the engraving) against the adjusting screws, and a chip the entire width of the key is taken off at each stroke of the cutter. To get the proper taper on the key, the table is tilted the same as when cutting keyways, the exact taper per foot being indicated by a graduated scale at the side of the machine. The thickness of the key is regulated by the use of the micrometer screw.

In cutting racks, the upper support for the cutter bar keeps the cutter in proper alignment and restrains it from springing away from the work. The micrometer screw is used for gauging the total depth of cut, and the other screw shown for regulating the depth of each stroke of the cutter.

The table is 46 inches long, 8 inches in width, and has two lateral T-slots milled through its entire length.

The screw is $1\frac{3}{16}$ inch diameter, provided with a bronze nut adjustable for wear. The index dial is graduated to thousandths of an inch. A suitable chuck is provided which will hold several racks to be cut at one operation.

The style of cutter used for cutting racks is shown in Fig. 1. Its construction is such that it will retain its shape until ground entirely down.

Fast trains on the Jaffa-Jerusalem railroad have hardly come to be a luxury. According to a correspondent of the *Moniteur Industriel* "the distance of 87 kilometers, or about 54 miles, between Jaffa and Jerusalem is supposed to be covered by the regular trains in 3 hours and 45 minutes, but in four cases out of six this time is said to be exceeded by two, three and even four hours. While the greater length of the line is comparatively level there are some heavy grades in the mountain sections on which the trains are frequently stalled, and must await the arrival of a second locomotive before they can proceed. This applies to the passenger trains. It is said the freight service is still worse, goods being often lost in transit."

MANUFACTURES.

The Duluth (Minn.) Brass Works has located at West Duluth.

The Webber Gas and Gasoline Engine Company, Kansas City, Mo., has issued an illustrated circular describing their engines.

Plans have been prepared for an additional mill 40x60 feet to be built by the Old Dominion Cotton Company at Manchester, Va.

The Owego Bridge Company, of Owego, N. Y., capital stock $50,000, has been chartered for the building of iron and steel bridges.

The Arctic Machine and Manufacturing Company, of Cleveland, O., is preparing plans with a view to making a large addition to its plant.

The Interlaken Mills, Arkwright, R. I., will build a 130-foot extension to the calender department and a 24-foot extension to the embossing room.

The Fort Worth Bridge and Iron Company, of Fort Worth, Tex., has been organized by R. N. Aatcher and others with a capital stock of $100,000.

The Toledo Bridge Company, of Toledo, O., is putting up a 90x250-foot addition to its plant which will be equipped with machinery for structural iron work.

The Meriden Machine Tool Company, Meriden, Conn., issue a large leaf of illustrated comparisons between their forming lathes and other methods of doing similar work.

The Ashby-Randall Journal Bearing Co., of St. Louis, has been formed to manufacture journal bearing boxes. F. J. Randall and J. L. Ashby, of Jennings, Mo., are interested.

A charter was issued recently for the incorporation of the Danversport (Mass.) Rubber Co. Capital stock, $10,000. The new company will do a business of reclaiming rubber.

The Springfield Drop Forging Company, Springfield, Mass., recently incorporated, is now erecting buildings which will contain the latest and most improved machinery in its line.

The West Monterey Brick and Manufacturing Company has been organized, and will build a works near West Monterey, Pa., on the Allegheny River. The company is capitalized at $40,000.

The American Enameled Fire Brick Company, of Allegheny, Pa., has been incorporated. The directors are: H. L. Dixon, R. E. Woods, H. F. Dorris, J. B. Dorris and J. C. Woods, of Pittsburgh.

E. W. Bliss Company, Brooklyn, N. Y., has issued five very fine illustrated circulars, printed in English, French and German, especially designed for the convenience of foreign visitors at the World's Fair.

The Murray-Miller Engineering Company, of St. Louis, Mo, capital stock, $50,000, has been organized for the manufacture of furnaces, machinery, construct water-works, etc., S. P. Galt, of St. Louis, is interested.

The Gravity Turntable Co., of Albany, N. Y., has been incorporated for the manufacture of locomotive turntables, etc. Herman Harder, W. G. Saunders, of Albany, and James Saunders, of Coxsackie, N Y., are among those interested.

The recently incorporated firm of the Morris & Bailey Steel Company, of Pittsburgh, Pa., is erecting buildings at Wilson Station, at which it is expected to increase the output of cold rolled steel to three times the amount it now turns out.

The Glens Falls Portland Cement Company, of Queensbury, N. Y., has been incorporated to manufacture cement, lime and brick. Capital, $48,000. Directors, W. W. Maclay, J. Fowler, S. L. Goodman, A. W. Sherman, F. W. Wait and others.

The South Milwaukee (Wis.) Malleable Iron Company has accepted plans for and will soon begin the erection of an addition to its plant at South Milwaukee, Wis. The new space, which will be used for molding purposes, will stand 170x70 feet.

Whiteley Malleable Castings Co., of Muncie, Ind., has been incorporated, with a capital of $200,000, to manufacture, produce and sell all kinds of castings, including malleable, steel and iron. The incorporators are: Burt H. Whiteley, George F. McCollough, Thomas Liggett.

The Duquesne Reduction Company, of Pittsburg, has been chartered for the manufacture of brass, lead, copper, zinc, tin, and to make specialties from the same. The directors are: Charles F. Hood, Sidney S. Klinordlinger and Samuel F. Hood. The capital is $25,000.

The Stirling Company, 74 Cortlandt street, New York, has recently sold 750 horse-power of boilers to Minneapolis (Minn.) Electric Company, 750 horse-power to J. G. Mattingly Company, Louisville, Ky., (second order), 150 horse-power to Taylor Chair Company, Bedford, Ohio.

E. G. Smith, Columbia, Pa., has received an order from Gilils & Gleason, in which is included 50 of his metric vernier sliding calipers for use in

industrial schools. The Pacific Tool and Supply Company, 100-103 First street, San Francisco, Cal., are Mr. Smith's agents for the Pacific coast.

The Bradley Mfg. Co., of Ashtabula, O., has been incorporated, with a capital of $150,000, for manufacturing wagons and other vehicles, parts of same, chandeliers, gas and electric light fixtures, etc. The incorporators are: W. H. Bradley, J. A. Bradley, Clarence E. Richardson, C. W. Jaques, T. E. Hoyt.

The foundation for the east side of the new structure for the Wamsutta Mills Corporation, New Bedford, Mass., is all in, and the underpinning on that part of the work is in position. The area of the new building is 214x127 feet, and it will be three stories high, giving upwards of 80,000 square feet of floor surface.

The Cheney Flexible Loom Reed Company has been organized at Lewiston, Me. J. Goodwin is president and H. Myrick, treasurer. The directors are: H. L. Pratt, H. Myrick, H. A. Chapin, J. Goodwin, B. Nichols and J. W. Cumnock. Authorized capital stock, $300,000. The business of the concern will be the manufacture of looms, reeds, etc.

J. A. Fay & Egan Co., Cincinnati, O., recently received a large order for equipping a planing-mill and a wood-working factory in Russia. This shipment will go *via* the Mediterranean Sea to Constantinople, thence *via* the Black Sea to Sebastopol, then by rail northward some two hundred miles to Bielgorod, a city of some 40,000 inhabitants.

Warren Webster & Co., of Philadelphia, are erecting a three-story brick building, 120x65 feet, in Camden, N. J. They will transfer their entire plant to the new building as soon as completed, and will supplement it with other machinery adapted to the requirements of their growing business. They expect to commence removal about the middle of July.

Communications from Charleston, S. C., state that the citizens of Cheraw have been agitating the building of a cotton factory for the past three months. It was at first proposed to start with $50,000, but now new stock is being secured, and they confidently expect to have $100,000 subscribed within the next sixty days, when work will begin. The officers of the company are: H. W. Finlayson, president, and W. R. Evans, secretary and treasurer. Commission to organize was granted in the latter part of April, and they will commence work on the plant about August 1, and expect to have it completed by the last of the year.

Machinists' Supplies and Iron.

New York, July 29, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.50 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $13.75 to $14.50 for No. 1 Foundry; $12.50 to $13.50 for No. 2 and $11.75 to $12.50 for Gray Forge.

Antimony—The market is dull. We quote L. X., 10.15c. to 10¼c.; Cookson's, 10.25c. to 10½c.; Hallett's, 9.80c. to 9.85c., and U. S. French Star, 10½c.

Copper—The market is dull. Lake Copper is quoted at 10c. for July and 10.05c. for August. No business is reported. Casting Copper is held at 9¾c. to 10c.

Lead—The market is weak with offerings at 3.35c. and 3.25c bid.

Lard Oil—Prime City is quoted at 72c. to 73c.

Spelter—The market is in a nominal condition at 3.95c. to 4c., but this does attract buyers.

Tin—The market is unusually dull, with a tendency towards lower prices. Sales of 15 tons September at 19.25c. are reported, and 75 tons August at 18.95c. to 19.05c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

An exp'd supt. of machine works and foundry is open to an engagement. Box 33, Am. Machinist.

Wanted—Draftsmen to sell new comb. triangle, pat. protractor, etc. D. J. Kelsey, New Haven, Ct.

Wanted position by experienced mechanical draftsman. Address A, care Am. Machinist.

Wanted—Situation by A1 blacksmith, thoroughly competent. Best refs. B. K., Am. Mach.

Draftsman wants pos.; has tech. education, and 2 years' exp. on gen. mach'y. Box 58, Am. Mach.

Mechanical draftsman leaving World's Fair employment, desires a position. Ll. H., Am. Mach.

Exp'd foreman in all kinds of press & die work, wishes pos. with good parties. Box 56, Am. Mach.

Foreman blacksmith wants position; good reference. Address Box 55, American Machinist.

Mechanical draftsman, good designer, expd., shop practice, wants position. G. D., Am. Machinist.

Wanted—An expert tracer and detail draftsman wants to make a change. X. Y., Am. Machinist.

Wanted—Position by a pattern maker, Swede, 3½ yrs. in U. S. Box 60, American Machinist.

Wanted position as sup't or foreman by machinist and toolmaker; large exp. in tool and dynamo building. Address Box 46, Simsbury, Conn.

Wanted—Position by an all-round, first-class wood pattern maker, 18 years' experience. Address O. F., American Machinist.

Pattern maker wishes pos. in Eastern or Atlantic States, 1st-class workman, steady & comp. on gen. mach'y & all wood patterns. Charles, Am. Mach.

Mech. draftsman, foreman, 12 yrs' experience on marine and stationary work desires a change, best ref. from present employers. Box 61, Am. Mach.

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✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

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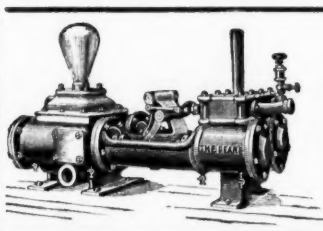

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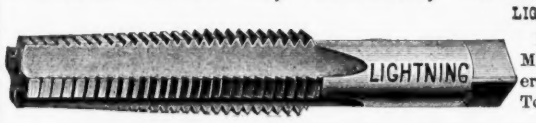

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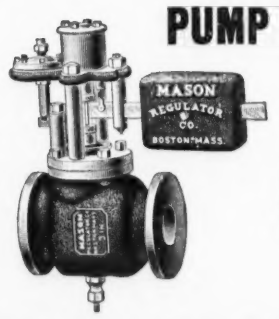

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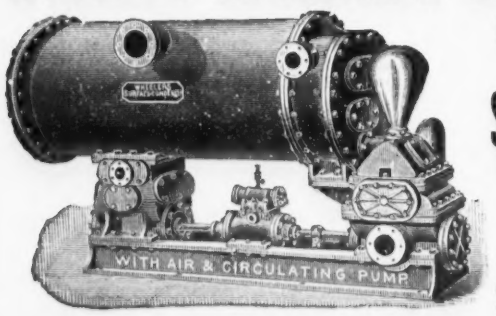

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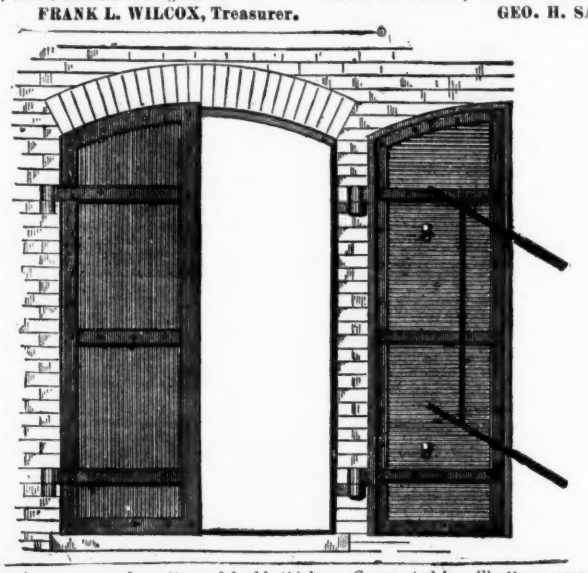

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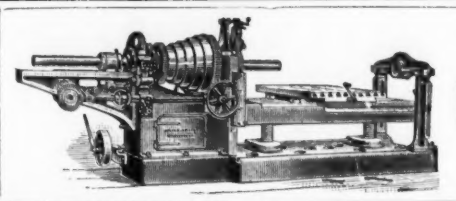

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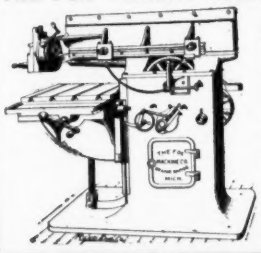

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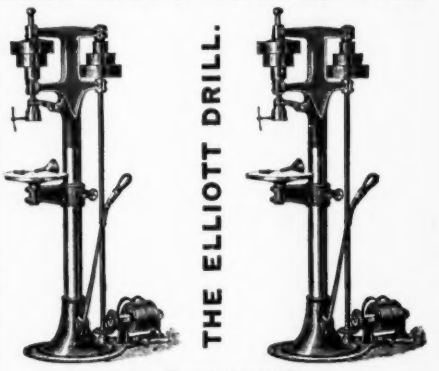

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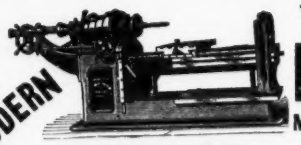

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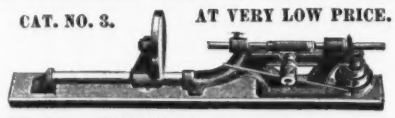

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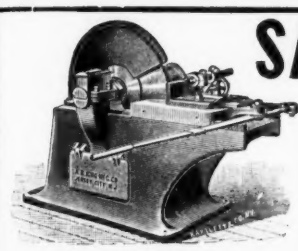

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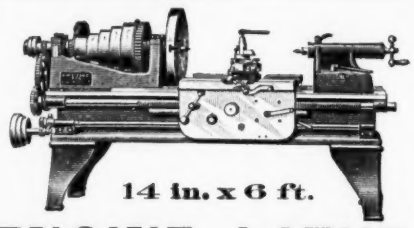

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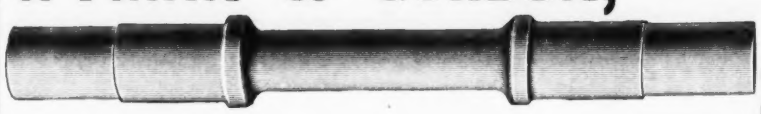

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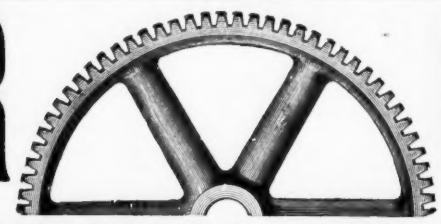

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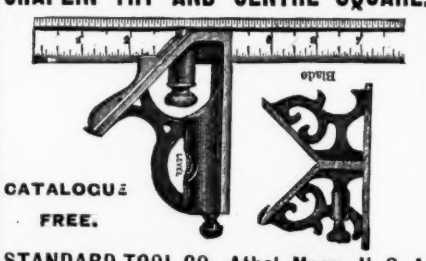

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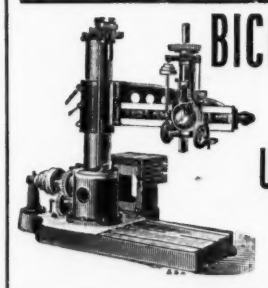

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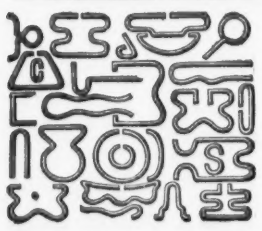

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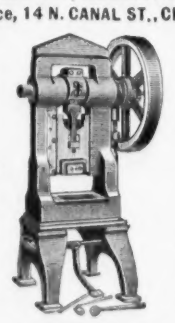

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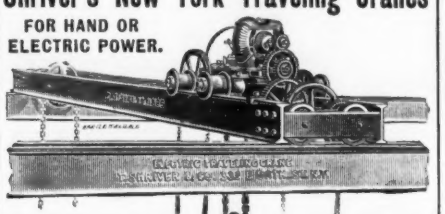

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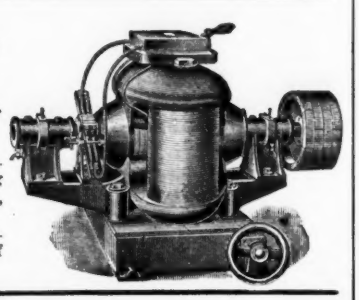

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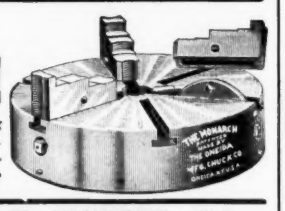

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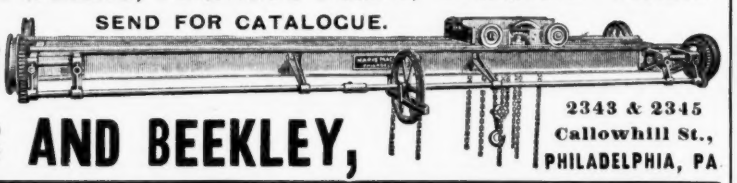

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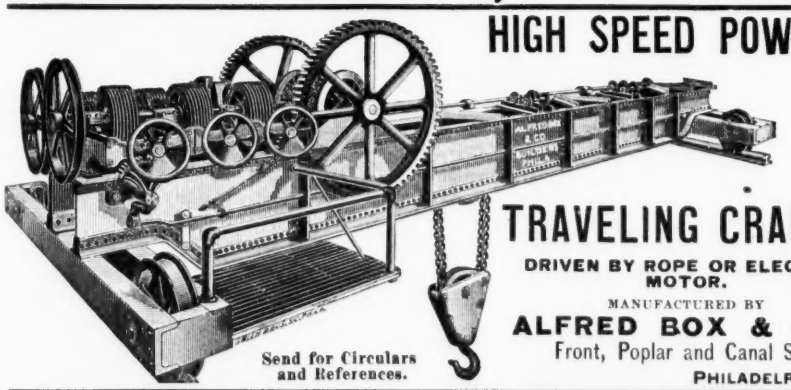

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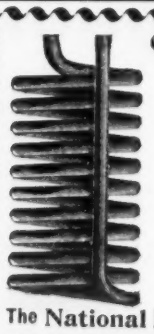

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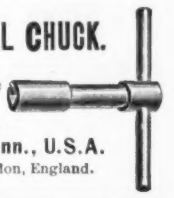

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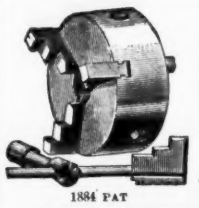

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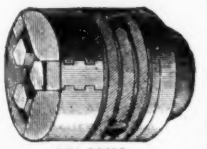

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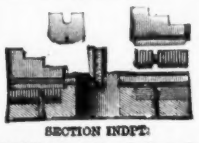

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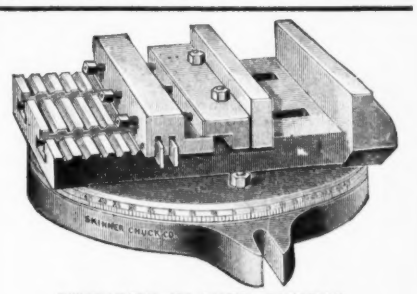

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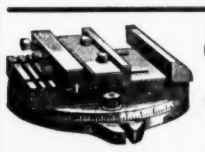

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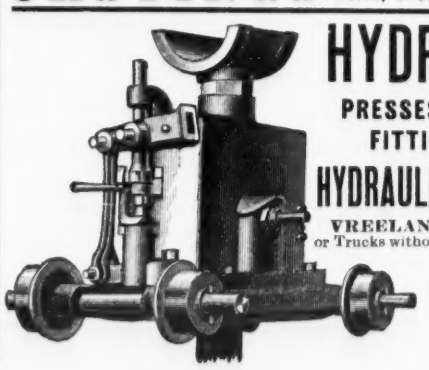

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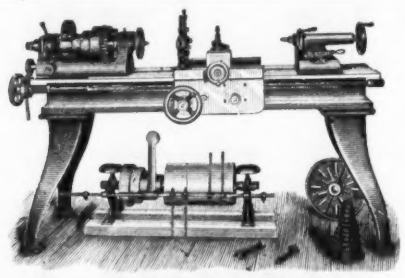

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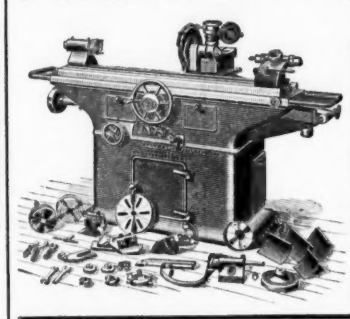

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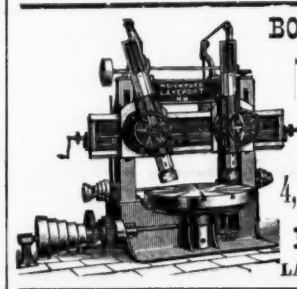

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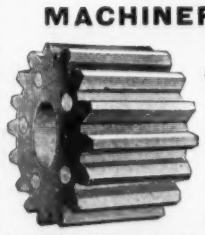

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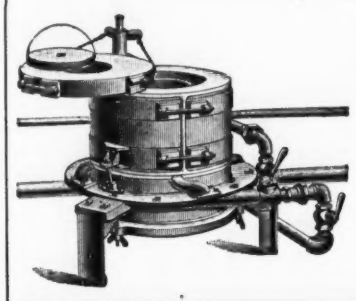

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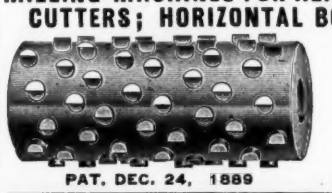

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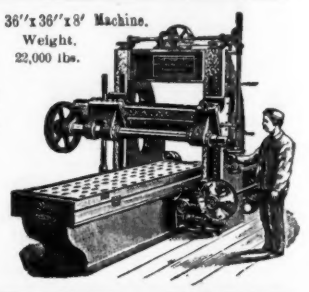

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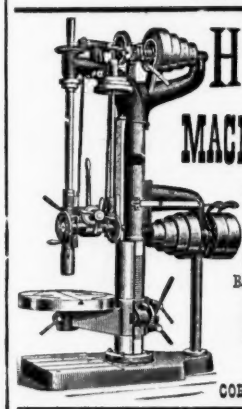

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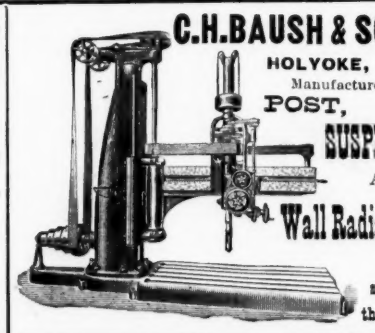

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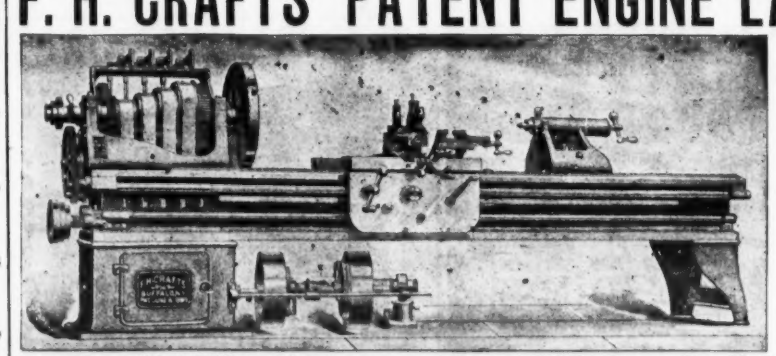

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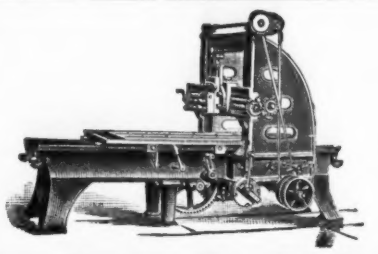

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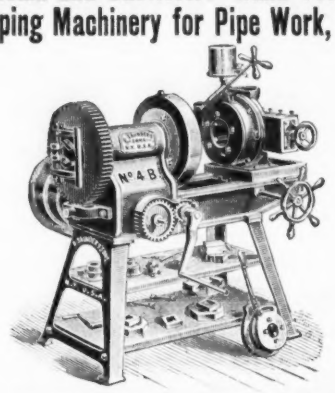

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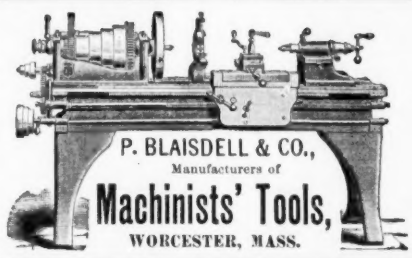

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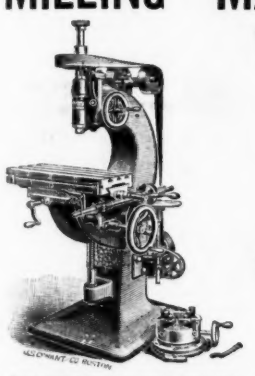

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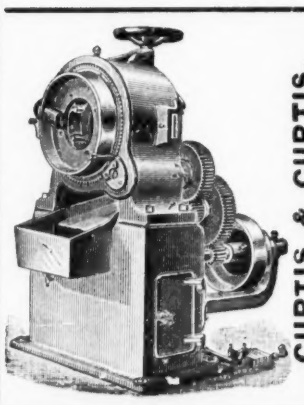

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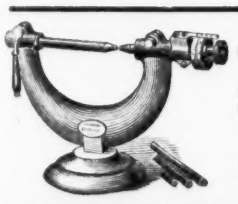

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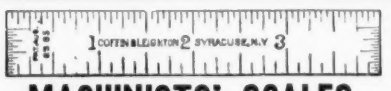

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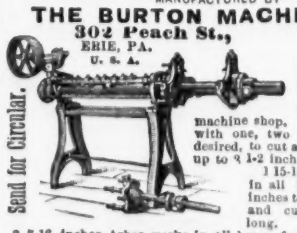

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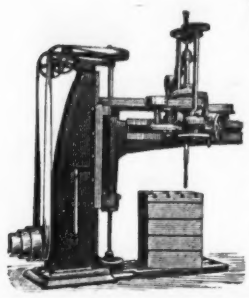

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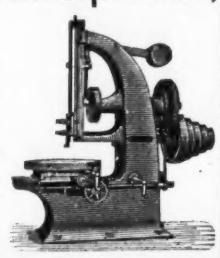

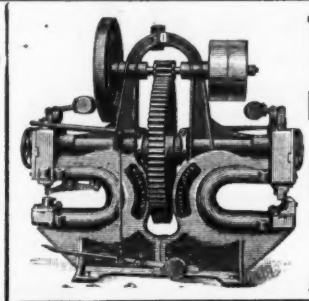

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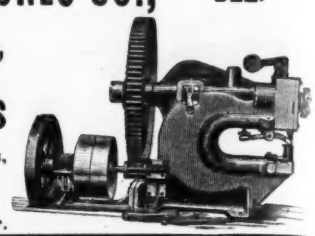

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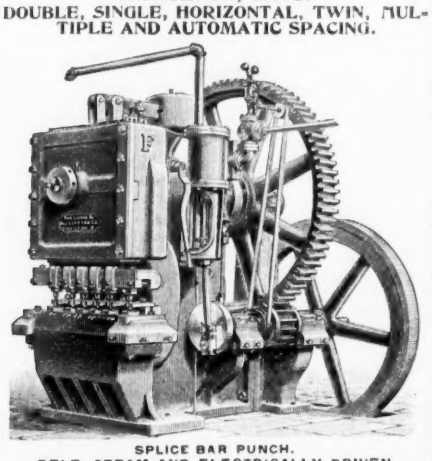

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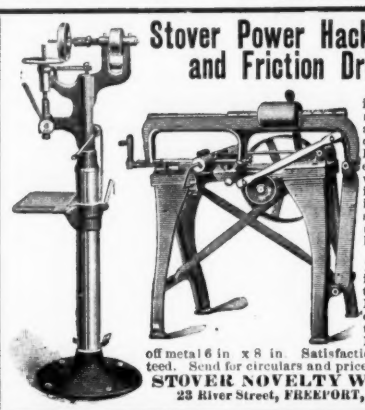

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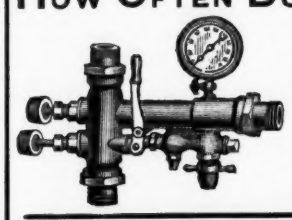

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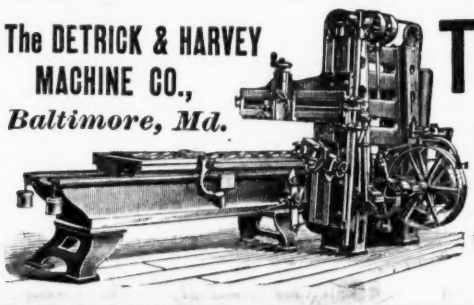

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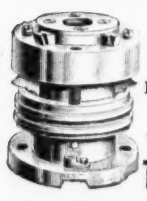

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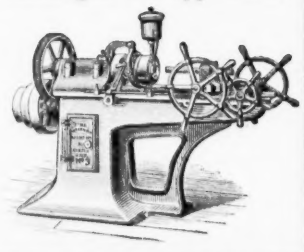

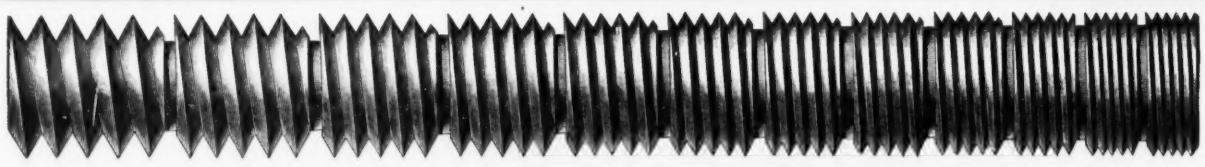

The above Cut shows 12 Threads from 6 to 20 per inch, cut in

THE NORTON LATHE

They were ALL cut in this Lathe WITHOUT changing gears.
The Lathe was NOT STOPPED during the whole operation.
The Carriage being reversed in the Apron the operator DID NOT touch the Counter Shaft Lever during the whole operation.
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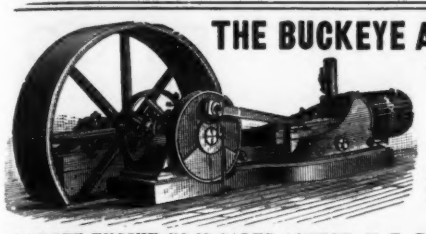

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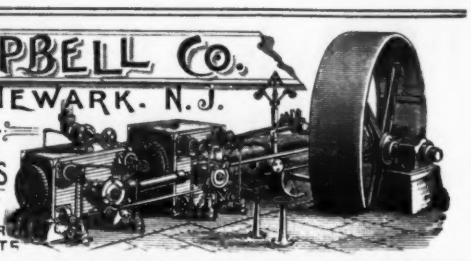

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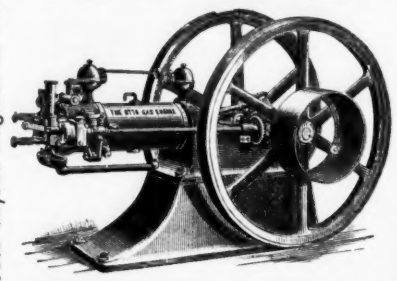

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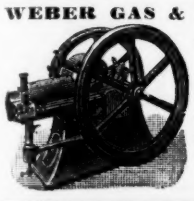

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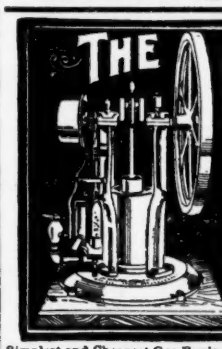

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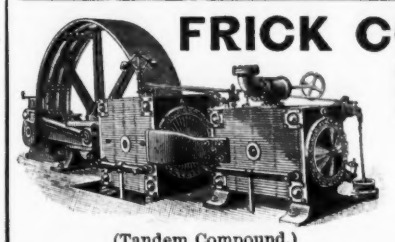

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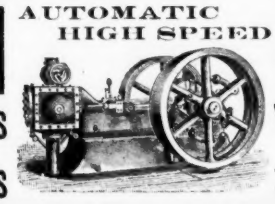

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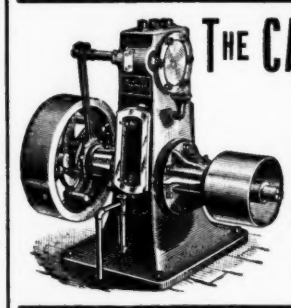

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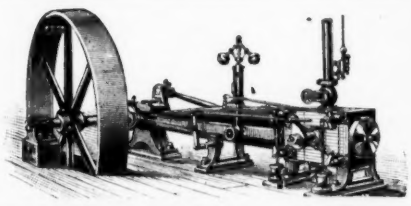

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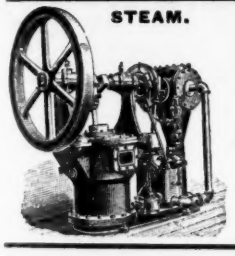

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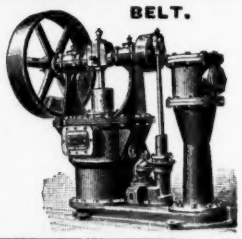

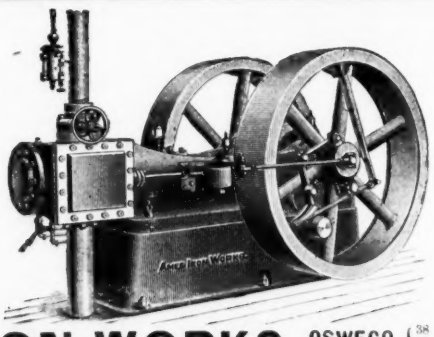

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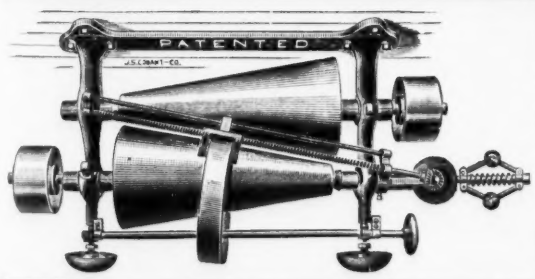

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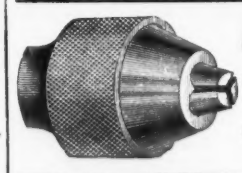

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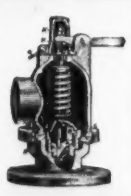

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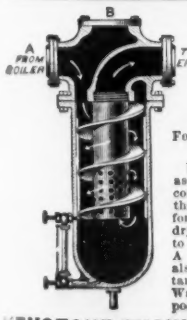

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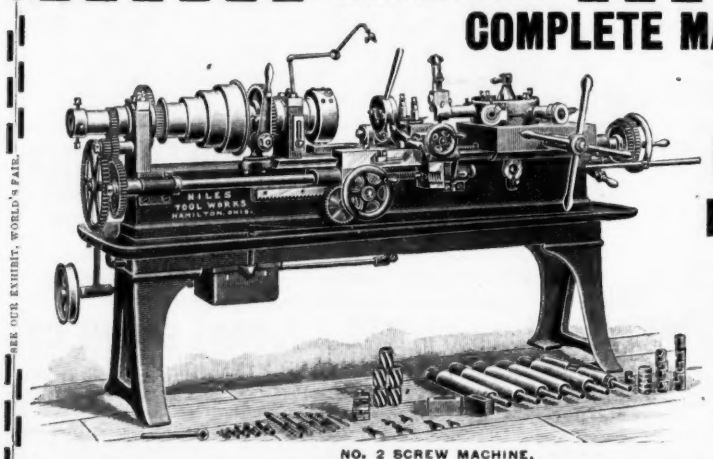

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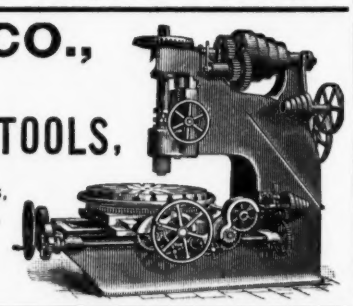

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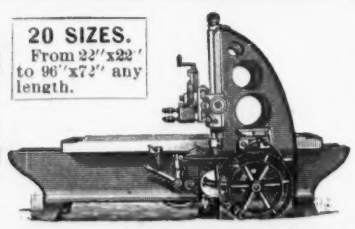

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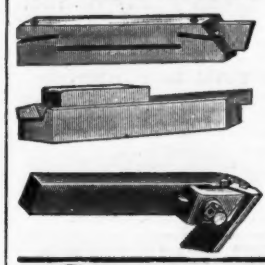

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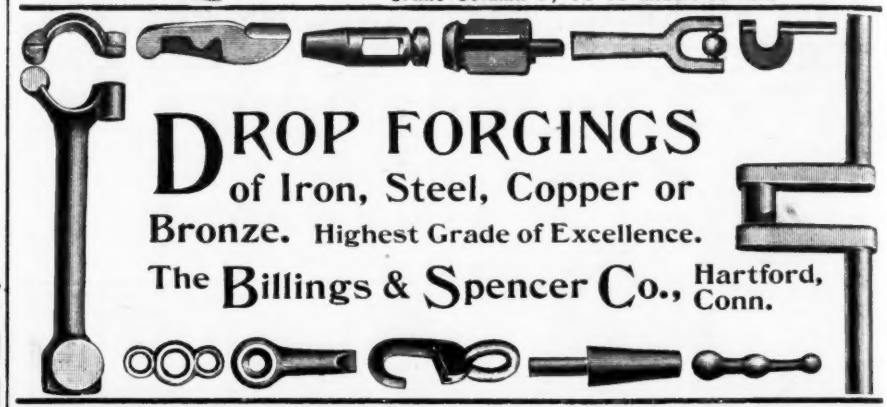

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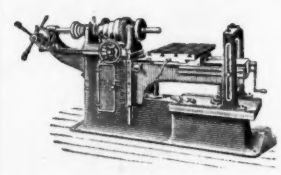

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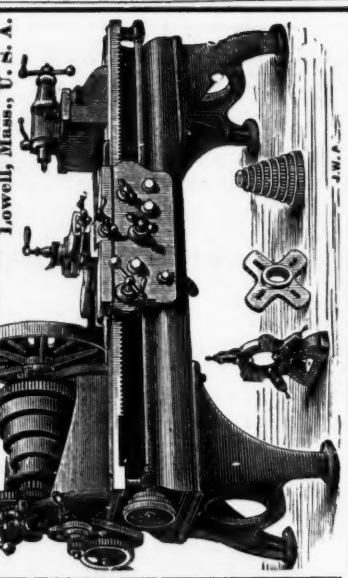

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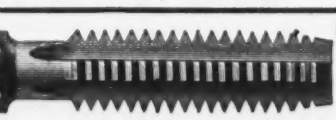

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